THE SCHOBER REVERBATAPE UNIT RV-1

KIT ASSEMBLY INSTRUCTIONS

This kit should contain the following parts. If any are missing or damaged, a replacement will be sent upon request to The Schober Organ Corporation, 43 West 61st Street, New York 23, N. Y.

QUAN.	DESCRIPTION	PART NO.
4	1,000-ohm, ½-watt resistors	011102
1	10,000-ohm, ½-watt resistor	011103
11	100,000-ohm, ½-watt resistors	011104
6	1-megohm, ½-watt resistors	011105
2	1500-ohm, ½-watt resistor	011152
1	15,000-ohm, ½-watt resistor	011153
1	150,000-ohm, ½-watt resistor	011154
1	220-ohm, ½-watt resistor	011221
3	2200-ohm, ½-watt resistors	011222
2	22,000-ohm, ½-watt resistors	011223
2	220,000-ohm, ½-watt resistors	011224
3	2.2-megohm, ½-watt resistors	011225
1	27,000-ohm, ½-watt resistor	011273
1	3300-ohm, ½-watt resistor	011332
1	330,000-ohm, ½-watt resistor	011334
1	470-ohm, ½-watt resistor	011471
1	4700-ohm, ½-watt resistor	011472
2	470,000-ohm, ½-watt resistors	011474
1	5600-ohm, ½-watt resistor	011562
2	560,000-ohm, ½-watt resistors	011564
1	68,000-ohm, ½-watt resistor	011683
1	8200-ohm, ½-watt resistor	011822
1	22,000-ohm, 1-watt resistor	013223
1	3-gang potentiometer	017104RV
1	1,000-ohm, 10-watt resistor	018102AF
1	2500-ohm, 10-watt resistor	018252AF
1	7,000-ohm, 10-watt resistor	018702AF
2	.001-mfd disc capacitors	020102
2	.01-mfd disc capacitors	020103
1	.005-mfd disc capacitor	020502
10	.01-mfd tubular capacitors	021103
2	.1-mfd, 200-volt tubular capacitors	021104
1	.15-mfd tubular capacitor	021154A
5	.1-mfd, 400-volt tubular capacitors	022104
2	.022-mfd tubular capacitors	022223
5	.033-mfd tubular capacitors	022333
1	.047-mfd tubular capacitor	022473
1	.001-mfd tubular capacitor	023102
6	.0022-mfd tubular capacitors	023222
1	.0047-mfd tubular capacitor	023472
2	40-30-30-mfd can capacitors	b2601
2	470-mmf mica capacitors	027470
1	Oscillator transformer	0314
1	Power transformer	03507
3	12AU7 tubes	0412AU7
5	12AX7 tubes	0412AX7
2	Top-hat silicon rectifiers	046050
20′	#18 bare wire	07318
6″	#22 bare wire	07322
1′	#22 brown wire	07501
6″	#22 red wire	07502
1′	#22 orange wire	07503
4′	#22 yellow wire	07504
1′	#22 green wire	07505
2′	#22 black wire	07500
4′	1-conductor shielded solid cable	07601A
2′	2-conductor shielded cable	07603
3′	1-conductor shielded stranded cable	07604
6′	6-conductor shielded cable	07605
3′	8-conductor cable	07702
4	8 x ¼ hex-head self-tapping screws (on box)	08011
1	6-32 x ⅞ self-tapping screw	08013
18	4-40 x ¼ screws	08120
8	4-40 x 2⅛ screws	08123
13	6-32 x ¼ screws	08131
6	6-32 x ½ screws	08133
4	6-32 x 1 screws	08137
3	6-32 x 2¾ screws	08140
4	8-32 x ½ screws	08141
18	4-40 nuts	0822
21	6-32 nuts	0823
4	8-32 nuts	0824
8	Small 4-40 nuts	0826
18	#4 lockwashers	0831
25	#6 lockwashers	0832
4	#8 lockwashers	0833
1	3/16″ tubular spacer	0843
4	⅝″ tubular spacers	0844
5	13/16″ threaded spacers	0845
1	17/32 tubular spacer	0846
8	1 5/16 tubular spacers	0848
1	#6 x 5/16 flat washer	08522
1	#5 x 1 wood screw	087851
1	⅞″ rubber grommet	08911
2	Mechanism mounting brackets (on box)	0919
1	Nylon cable clamp	0962
1	Double phono jack	10103
10	Magnetic head connection clips	10104
1	Line cord with plug	10202
1	8-pin female connector	10401
1	8-pin male connector, with cap and pin	10402
1	Strain relief	10501
1	Printed circuit	11101U
1	Printed circuit	11101L
1	Printed circuit	11102U
1	Printed circuit	11102L
1	Printed circuit	11104U
1	Printed circuit	11104L
3	Printed circuits	11105U
3	Printed circuits	11105L
1	Printed circuit	11106U
1	Printed circuit	11106L
1	Printed circuit	11107U
1	Printed circuit	11107L
1	Fuse holder	1831
1	1½-ampere fuse (in holder)	1411
1	Power supply chassis	15501
1	Flat chassis	15502
1	Phenolic rear cover plate	15503
1	Mechanism assy, with tape, cover, 3 resistors, flywheel, and Allen wrench	16112
1	7-pin male plug	1807
1	Cap for above plug	1807C
8	9-pin male plugs	1809
9	9-pin printed-circuit tube sockets	1819
8	9-pin chassis-mounting tube sockets	1820
1	7-pin chassis-mounting tube socket	1821
2	Phenolic capacitor mounting plates	18211
1	7-pin tube socket less metal saddle	1822
1	Single tie point	19101
2	Double tie points	19102
2	Quadruple tie points	19104
2	Single solder lugs	1927
6″	Yellow vinyl tubing	25304

Preliminary Data

This instruction book shows you, in step by step fashion, how to assemble your REVERBATAPE Unit. Other literature tells you how to install it on any organ and what to do if any trouble develops, and gives photographs and full schematic diagrams, as well as a technical explanation of how the REVERBATAPE Unit works.

You should read all of the following preliminary data to be sure that you will assemble your REVERBATAPE kit

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correctly. Much of the following general material is the same as is given in the General Instructions for Schober Electronic Organ Kits. If, therefore, you have built a Schober Organ, you need not read those parts in any great detail.

Guarantee and Parts Replacement

The Schober Organ Corporation warrants all parts for a period of one year from date of shipment and will replace any part which is or becomes defective within that period unless the defect is obviously due to misuse or failure to follow instructions. Parts to be replaced should be returned, transportation prepaid. A letter or postcard must be sent *separately* requesting the new part and detailing as far as possible the trouble with the old one. After expiration of the guarantee, a nominal charge may be made for any necessary replacements.

Tools and Instruments

Only ordinary hand tools are necessary. These should include two or three screwdrivers of different sizes, long-nose pliers, diagonal cutting pliers, a ½" and a ¼" nut driver, and gas or "slip-joint" pliers. Some other small tools may come in handy if you have them.

You will need solder and a soldering iron. The solder *must* be either Ersin Multicore, 60/40, or Kester Resin-Five, 60/40, either one preferably in No. 16 wire gauge. The soldering iron *must* be an Ungar No. 776 handle with cord, plus No. 1235 37½ watt heating unit, and No. PL333 ⅛-inch diameter plated chisel tip. Both may be bought locally, or you may order them from Schober, at $3.60 for the iron and $2.00 for 1 lb. of solder, both postpaid.

WARNING: If you do not use the exact solder and soldering iron listed in the above paragraph, our guarantee on printed circuits may be voided. With the listed equipment you will have no trouble whatever with printed circuits; with a substitute, no matter how close the substitute may be to the prescribed material, you may damage the printed circuits, and we will replace such circuits (and any necessary components on them) only at full charges.

You need only a small working area to assemble your REVERBATAPE kit. A card table or a kitchen table with a nearby electrical outlet is sufficient.

Following Instructions

It is absolutely essential that you follow each instruction during your kit building. The instructions are written and illustrated in such a way that nothing is left to your imagination and no previous knowledge is assumed. They tell you how to do everything that must be done and they specify the sequence of doing it. Our guarantee is valid only if you have followed all instructions, regardless of how much you may know about electronics.

We realize that those very familiar with electronics tend to skimp in reading instructions and to depend too much on their experience. This can result in serious errors.

This instruction manual contains numbered steps, which must be followed in the sequence given. It is best practice to read through the entire manual before starting work, trying to visualize each operation. Knowing what is coming, you will be in a more knowledgeable position during the actual work.

If any instruction or operation is not clear to you, don't guess! Write or phone us for an answer. While past experience indicates that almost no one requires clarification of any written material, we know that it is impossible to write anything that is 100% clear to *all* people of infinitely varying backgrounds, locations, and experience. We gladly furnish any advice or clarification you need.

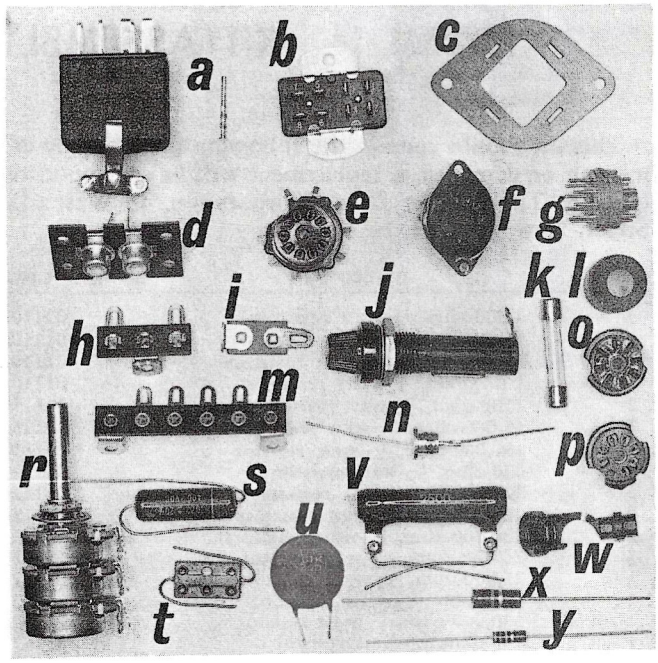

Photo A — Electronic parts: (a) 8-pin male connector and pin; (b) 8-pin female connector; (c) capacitor mounting plate; (d) double phono jack; (e) 9-pin printed-circuit tube socket; (f) chassis-mounting tube socket; (g) 9-pin male plug; (h) double tie point; (i) single tie point; (j) fuse holder; (k) fuse; (l) rubber grommet; (m) quadruple tie point; (n) silicon rectifier; (o) 7-pin male plug (connection loops shown — pins underneath); (p) 7-pin tube socket without metal saddle (control socket); (r) 3-gang control potentiometer; (s) tubular capacitor; (t) mica capacitor; (u) disc capacitor; (v) 10-watt resistor; (w) strain relief; (x) 1-watt resistor; (y) ½-watt resistor.

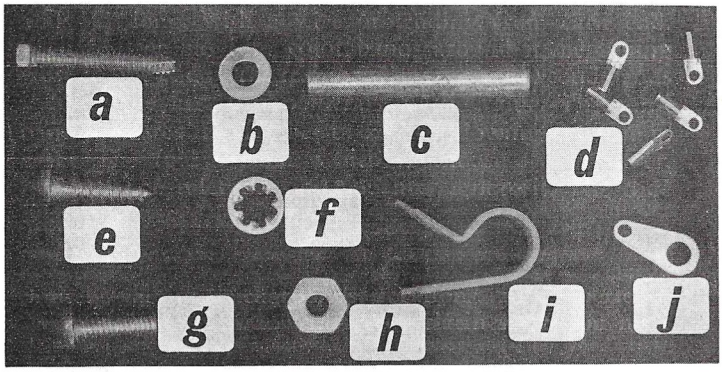

Photo B — Hardware: (a) hex-head self-tapping screw; (b) flat washer; (c) tubular spacer; (d) magnetic head connection clips; (e) wood screw; (f) lockwasher; (g) machine screw; (h) nut; (i) nylon cable clamp; (j) single solder lug.

Identifying the Parts

Each of the parts used in this kit will be identified when you come to it in the instructions. See also Photos A and B. We give here, however, the color code which is used to identify resistors and some wires.

Most resistors are small tubular units ⅛" in diameter and ⅜" long, with a wire protruding from each end. Each resistor has four color bands around it, beginning close to one end of the resistor. The first and second bands indicate the first two numerals of the value. The third band indicates the number of zeros following these numerals. The fourth band, which is almost always silver, indicates the tolerance and you may ignore it. The code is as follows:

1 — Brown	6 — Blue
2 — Red	7 — Purple
3 — Orange	8 — Gray
4 — Yellow	9 — White
5 — Green	0 — Black

For instance, assume a resistor which has nearest one end a brown band; next red; and third orange, followed by the usual silver band. The numbers indicated by these colors are 1, 2, 3. The resistor value is 12,000-ohms. In the instructions the colors of the resistor bands will be indicated, though the silver band will not be mentioned.

How to Solder

Soldering is simply the process of melting a small amount of a very soft metal and allowing it to flow over an electrical connection, so that when it hardens the joint is encased in metal, guaranteeing good electrical contact and "burying" the connection so that no corrosion can reach it to mar the contact in the future.

There are only two main requirements for making a good solder joint. (1) Both the solder and the two pieces of metal being joined (one of which is usually a wire) must be hot enough so that (a) the solder is thoroughly liquid and (b) the metal pieces are actually "wetted" by the liquid solder, which will then merge with them; and (2) once the solder has thoroughly "wetted" the metals, and the iron has been removed, no part of the connection must be allowed to move until the solder has hardened completely (usually 5 to 10 seconds). Both pieces of metal must, of course, be clean and free of corrosion, as solder will not join corroded metals. Also, except on printed circuits, solder alone should rarely be relied on to hold a connection mechanically; a wire being connected to a lug or a tie point should first be wound around the point or hooked to a hole, etc., and clinched with long-nose pliers. *Then* it should be soldered.

In connecting an insulated wire to anything, the insulation must first be stripped from the end of the wire. The best way to do this is to use a wire stripper. With less ease and with more danger of damaging the connection to the other end of the wire, it can also be done by grasping the insulation lightly a short distance from the end with diagonal cutters and, with the other hand, sharply pulling the main part of the wire away. You can also use a razor blade. In any event, try not to nick the wire itself, as this will weaken it.

To connect any wire to a lug or terminal or tie point (including tube-socket pins), all of which usually have holes, bend the end of the wire over, insert it through the

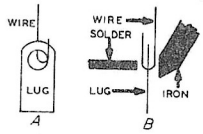

Fig. 1 — Soldering to lug, tie point, or tube pin. Hook wire through hole, clinch, then apply iron and solder to metal.

hole, *and clinch the wire loop with pliers.* Fig. 1A shows a typical connection to a lug or tube pin. If the wire is insulated, you should have stripped only enough insulation from the end to allow the connection. The insulation should come almost to the lug, so that after connecnection there is not enough uninsulated wire end to accidentally touch anything else. On pre-cut transformer wires, simply clip off as much of the stripped bare wire as you do not need for the connection, so the insulation almost reaches the pin or lug. (On printed circuits, clip off excess bare wire only after soldering.)

After making sure the connection is mechanically suitable — meaning that the wire will not come free from the pin or lug when you cease to hold it in place — you may solder it. Fig. 1B shows how this is done. The drawing shows an edge view of the lug or pin. The various pieces are shown separated for clarity, but actually, of course, the flat on the end of the soldering-iron tip is touching the wire and the lug, as is the solder from the other side. Note that the solder is applied to the lug and wire — *not* to the iron. This insures that the lug and wire will be hot enough before the solder starts to melt. Let enough solder melt and flow over wire and lug to cover the jointed surfaces smoothly; make sure the solder is quite liquid and shiny. Then remove iron and solder and do not allow the wire to move for several seconds until the solder hardens. (You may blow on the joint to hasten this.) You will notice a subtle change in appearance at the moment the solder hardens; but the hardened solder should remain almost as shiny as when it was molten. The finished solder surface should be smooth, without ripples. Ideally, the solder coating should be thin enough to show the outlines of the wire and lug or pin (and it will usually fill the hole if the hole is not large). However, too much solder is not harmful as long as it does not touch any other metal part. At all points where solder ends and original metal begins to show, the two should blend smoothly. If in doubt about any solder connection, simply reheat it.

Any soldering iron will work well only if its tip is kept "tinned" with a thin coat of shiny solder. When you start using a new iron, let it heat first. Then wipe the tip with a cloth and immediately touch solder to it. Allow the solder to melt and thickly cover the entire working tip of the iron. The Ungar tip specified has a special plating which will not allow it to corrode. You must still tin the iron the first time you use it, but the whole surface will take solder easily and will not corrode in the future.

Every time thereafter when you pick up the iron, look at the tip. If it is not bright and shiny, wipe it with a piece of cloth. This is all that is necessary for the Ungar.

Only a clean, tinned iron will transmit heat to a joint. An iron tip not clean and bright will only waste lots of time and may result in a "cold solder" joint which may look fairly good but in which the solder was applied with insufficient heat and therefore did not combine smoothly and thoroughly with the metals being joined.

Printed Circuit Soldering

A printed or etched circuit is a board about 1/16" thick made of an insulating phenolic substance, with a pattern of lines and circles of copper foil firmly adhered to one surface. The lines of copper carry current and substitute for wires, and the circles with holes through them are connection points for the wires of the components.

The instructions will tell you how to pass the wires of the components through these holes. Your task will then

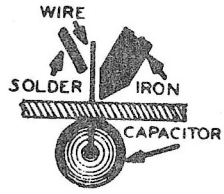

Fig. 2 — Soldering to printed circuit. Apply iron tip to copper, flat to wire, then melt solder over both. Be sure solder melts thoroughly and use plenty.

be to solder the wires to the copper circles surrounding the holes. Fig. 2 shows how this is done. Fig. 2 is an edge view of the printed circuit. In this case the capacitor is on its side against the blank (non-copper) face of the board. The wire emerges on the surface which has the copper

circle. One of the flat faces of the iron tip is held against the protruding wire, with the tip of the iron resting on the copper circle around the hole. The solder is held against the wire so that it melts when the wire becomes hot enough. It will then flow down over the wire on to the copper. *The iron must be held in place until solder flows right out to the edges of the copper circle.* Be sure to apply enough solder so that a good, round globule is formed, not just a thin film. Too much solder cannot do any harm unless it is so much that it begins to overflow the copper circle. This will happen only with really excessive amounts of solder, as the solder wants to stay on the copper and does not tend to adhere to the insulating surface. When the solder has flowed to the edges of the

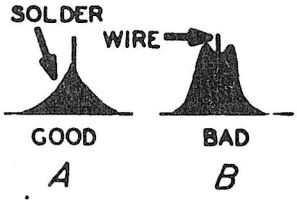

Fig. 3 — Good solder joint (A) shows solder blending smoothly into wire. With poor joint (B) little crater at top shows solder has not bonded to wire. Reheat.

copper circle so that it forms a fat, round globule, remove the iron and allow nothing to move until the solder has hardened.

Always inspect the point where the wire emerges from the solder globule. If the wire has been heated sufficiently, the solder will flow smoothly into the wire, as in Fig. 3A. If the wire was not hot enough, the wire will appear to emerge from a small crater, as in Fig. 3B. If that happens, re-heat the joint until you obtain the effect of Fig. 3A.

In any printed circuit soldering, there will always remain bits of brown substance on the board. This is the flux that was in the solder and it should *not* be cleaned off.

Only two things require special care in printed circuit soldering. You must be sure that you do not "pour on" so much solder that it overflows the connection circle and makes a short circuit to an adjacent line or circle. As you will see, it is very easy to avoid this and still leave a big, fat globule of solder which will mean a good connection. And you must not keep heating a part of the copper very much longer than necessary to melt the solder thoroughly and make the connection. A great deal of excessive heat will destroy the adhesive which bonds the copper to the insulating material and cause the copper foil, which is very thin, to "life." If you use the recommended iron only and are not extremely careless, no such damage can result. *"Lifted" copper is evidence of carelessness or use of an iron other than that recommended; a replacement printed circuit will be furnished only at extra cost.*

Safety Precautions

Voltages and currents inside the completed REVERBATAPE Unit and Power Supply can be dangerous or even fatal when it is turned on (or even when the power cord is connected). It should normally never be necessary to work inside the instrument with the power on; when it is completed the insulated rear cover plate should always be in place, and this adequately protects you against accidental shock.

However, if you should have to work inside the instrument with the power on, for instance in repair or service work, it is extremely easy to avoid all hazards by following one simple rule: NEVER TOUCH ANY PART OF THE EQUIPMENT WITH MORE THAN ONE HAND AT A TIME WHEN POWER IS ON AND FOR 30 SECONDS AFTER IT HAS BEEN TURNED OFF. This simple precaution will prevent any possibility of current passing through your heart in case you accidentally touch a component or wire with exposed high voltage. You should always, of course, avoid touching any uninsulated wiring or components with power on and for several seconds after it is off, except for chassis and cabinet, which are grounded and are therefore safe if correctly wired.

Because adherence to the simple rule above will give you complete safety, The Schober Organ Corporation can assume no liability for any damage or injury incurred in connection with your REVERBATAPE Unit. The power-supply fuse prevents any possibility of fire or damage to your house wiring in case of a short circuit in the unit. You must always use a fuse rated at not more than 1½ amperes and you must never bypass the fuse holder to avoid the necessity of replacing a fuse.

The Schober REVERBATAPE Unit is designed to operate only on power line voltages between 105 and 120 at 60 cycles a.c. Fifty-cycle voltage may be used without damage, though the reverberation effect will be slightly different. Connection of the unit to a direct-current (d.c.) power line will damage it, usually requiring a new motor and new power supply transformer.

You should always, of course, work carefully, taking the same precautions as normally called for in using ordinary tools.

Assembly Instructions

1. You will begin by assembling the Power Supply. Fig. 4 shows the top and front of the power supply chassis. Notice that each of the holes is marked with a letter from A through T (with the letters I and Q not used). Compare your steel chassis to the drawing and use a soft pencil to mark the same letters near the holes. From this point on, the holes in your chassis will be referred to by these letters.

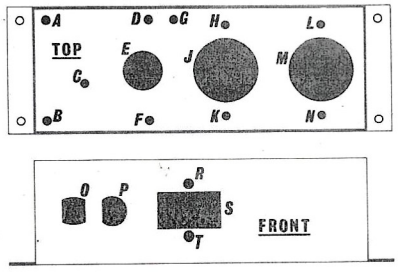

Fig. 4 — Use soft pencil to letter your Power Supply chassis holes according to this drawing.

2. Find the capacitor mounting plates and 4 6-32 x ¼ machine screws. The screws are from your #6 hardware package; they are ¼" long, measuring from the underside of the head. (The lengths of all screws are measured in this way.) Find also the 2 4-term-

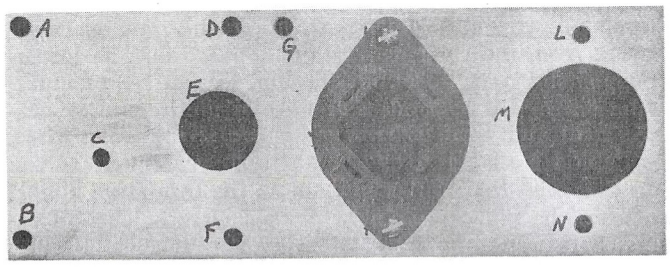

Fig. 5 — The capacitor mounting plate is against top of chassis, screws going into holes H and K.

inal tie points, 4 #6 lockwashers, and 4 6-32 nuts.

3. Pass a screw through each of the small end holes in one of the capacitor mounting plates. To get a screw all the way through the hole, you may have to rotate it with a screwdriver, as the holes are sometimes a trifle small.
4. With your chassis upright on the table, pass the two screws down through holes H and K. See Fig. 5.
5. Holding the two screws and the capacitor mounting plate in place with your fingers, turn the chassis

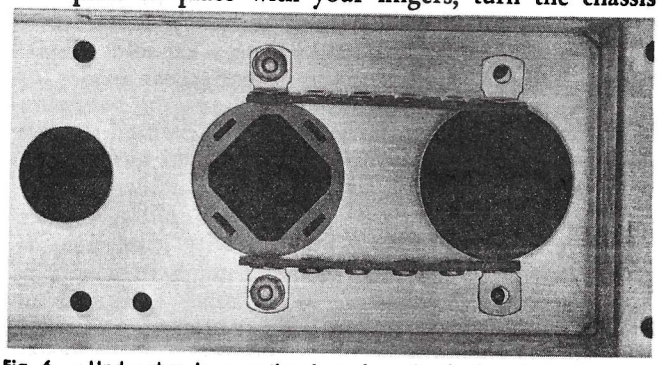

Fig. 6 — Under chassis, mounting feet of quadruple tie points are placed over screws, followed by lockwashers and nuts.

upside down and refer to Fig. 6. Over each of the screws as they emerge under the chassis, place one mounting foot of a quadruple tie point. Notice in Fig. 6 how the tie points are arranged — the ends in such a direction that the unused mounting feet are under holes L and N, the insulated bodies toward the center of the chassis.

6. Over each of the screws place a lockwasher and a nut. Do not tighten the nuts yet.
7. Mount the other capacitor mounting plate in exactly the same way, over hole M, the screws going through holes L and N and the remaining mounting feet of

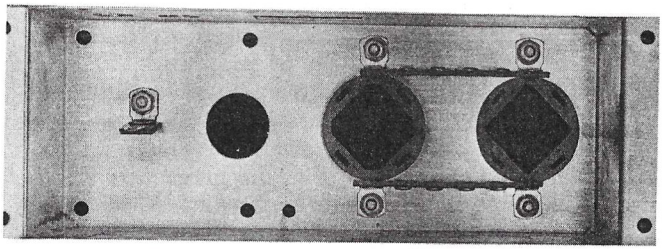

Fig. 7 — Mount remaining capacitor plate in same way, screws going through other tie point mounting feet, adding lockwashers and nuts. For step 8, notice position of a single tie point at left.

the tie points. Add lockwashers and nuts. Then tighten all four screws firmly. See Fig. 7.

8. Find a 6-32 x 1/4 screw, a 6-32 nut, and two #6 lockwashers, as well as a single tie point. Pass the screw through hole C in the chassis so that the screw head is outside the chassis. Turn the chassis upside down while holding the screw in place, and place over the screw one lockwasher. Now place over the screw the mounting foot of the single-terminal tie point, followed by a second lockwasher and the nut. Referring to Fig. 7, notice the exact position of the tie point. Hold it in this position and tighten the screw firmly.
9. Find your power transformer 03507, 4 8-32 x 1/2 machine screws, 4 #8 lockwashers, and 4 8-32 nuts.
10. With your chassis right side up, place the transformer on top of the chassis so that all the wires go down through hole E, and the four mounting slots at the base of the transformer are directly over holes A, B, D, and F. Pass each of the four screws down through a transformer mounting slot and into one of the holes, securing it in place by adding a lockwasher and a nut under the chassis. Square up the transformer neatly with the chassis, then tighten all screws firmly. Be sure all the wires go freely through hole E and none are pinched under the transformer. The Power Supply photo in the service manual shows you how the mounted transformer looks.
11. Find the rectangular 8-prong power socket, 2 6-32 x 1/4 machine screws, 2 #6 lockwashers, and 2 6-32 nuts. Turn the power supply chassis upside down so that the top of the transformer rests on the table.
12. Hold the socket so that the white numbers designating the protruding terminals at the rear read rightside up — that is, the numerals 7, 5, 3, and 1 are uppermost. (See Fig. 10.) Pass the blank face of the socket through the cutout in the side of the chassis from inside the chassis, so that the body of the socket is within the chassis and the two mounting angles attached to the socket are over chassis holes R and T. Pass a screw through hole R from outside the chassis and through the mounting angle of the socket. Add a lockwasher and nut, and tighten firmly to hold the socket in place. In the same way use another screw, lockwasher, and nut through hole T to fasten down the other socket mounting angle. This may be a little awkward if you have large fingers; it may take a few tries, but you can do it. Now check the rear of the socket to see that with the chassis upside down the numbers on the rear of the socket read rightside up.
13. Find the fuse holder; remove the large steel nut and the lockwasher from it. Leave the rubber ring in place. Notice that the nut has a cutout which enables you to pass it over the terminal which is lying flat along the barrel of the fuse holder. Pass the body of the fuse holder through hole P in the side of the chassis, from outside the chassis. Notice that hole P is D-shaped and there is a flat on each side of the fuse holder body. One of these flats must correspond with the flat part of the hole. As you insert the fuse holder in hole P, rotate it so that with the chassis upside down, after the fuse holder barrel is inside the chassis the metal terminal which lies flat along the fuse holder barrel is uppermost. Refer to Fig. 8. After you insert the fuse holder in hole P, the rubber ring should be against the outside of the

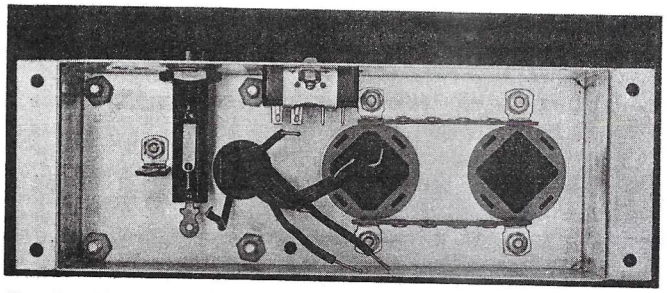

Fig. 8 — Underside of Power Supply with transformer wires coming through hole E, and fuse holder and 8-prong socket mounted.

chassis. Replace the lockwasher and nut over the fuse holder barrel inside the chassis, and tighten the nut with pliers or an open-end wrench. Tighten the nut firmly, but be very careful not to use any real force, as this could crack the plastic. Now bend the end terminal of the fuse holder so that it juts out

straight back, as indicated in Fig. 8, and pry up the flat side terminal a little so it will be possible to pass a wire through the hole.

14. Find 1 6-32 x ¼ machine screw, 2 #6 lockwashers, a 6-32 nut, and a double tie point. Fasten the double tie point to the underside of the chassis, with the screw going through hole G, in the same way you fastened the single tie point in step 8. The insulated body of the double tie point should be parallel to the near wall of the chassis and away from it. You can see its orientation in Figs. 9 and 10.

15. Find the two electrolytic capacitors. These are cylindrical metal cans about 4 inches long, with terminals at one end. Notice that each capacitor has (a) 4 *mounting ears,* 3 of which have small holes in them, equally spaced around the bottom of the cylinder, and (b) 3 large *connection terminals,* which emerge from the brown insulation disc. At the base of each connection terminal, the insulation disc carries an identification marking — a semi-circle, a square, and a triangle. These 7 metal projections we have just described will be indicated in the following instructions by the terminology we have used: mounting ears — with and without holes; and connection terminals — triangle, square, and semi-circle-marked.

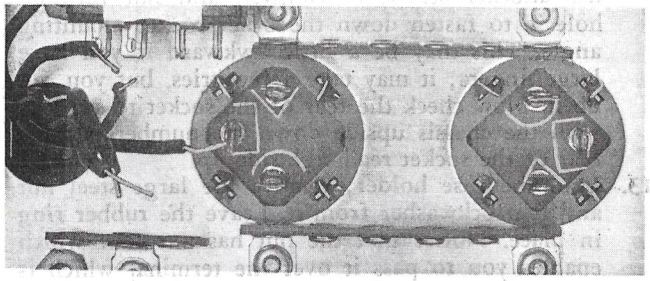

Fig. 9 — When you install large can capacitors, be sure markings on insulating discs at their bottoms are turned as shown here.

16. Holding the chassis upside down, place the terminal end of one capacitor over the center of the capacitor mounting plate nearest the transformer. The capacitor is on the transformer side of the chassis, that is, on the top. Turn the capacitor so that the triangle-marked connection terminal is nearest the chassis wall on which the 8-prong socket is mounted. Look closely at Fig. 9 to see how this looks. Insert the four mounting ears through the four slots in the capacitor mounting plate. Holding the bottom of the capacitor tightly and squarely against the capacitor mounting plate, use a pair of long-nose pliers to twist each of the four mounting ears a full quarter turn in the clockwise direction (to the right). This will hold the capacitor firmly in place. Pliers whose jaws have a fairly broad end, rather than a fine-pointed end, are better for this operation if you have them.

17. In exactly the same way mount the other capacitor to the other capacitor mounting plate. This time, however, the semicircle-marked terminal should be nearest to the chassis wall containing the 8 prong socket. Before going on to the next step, examine the 2-terminal tie point to see that the terminal nearest the transformer is not touching the nearby nut of a transformer mounting screw. If it is too close, loosen the tie point screw and rotate the tie point slightly so there will be no danger of touching.

Power Supply Wiring

18. Before beginning to wire the power supply, carefully examine Fig. 10. This drawing shows all of the items to which connections will be made — all the tie points, the capacitor mounting terminals, the fuse holder, and the 8-prong socket. When a particular letter point is referred to in the following wiring instructions, refer to Fig. 10 and be sure you have identified the correct point. If you are unfamiliar with soldering, refer again to the information on soldering in an early section of this instruction manual. Do a careful job on every solder joint. It is especially important in the power supply to use enough heat — that is, to leave the soldering iron in contact with the joint long enough to melt the solder thoroughly — as large metal surfaces can conduct heat away rapidly. A joint soldered without sufficient heat will not last, and will eventually give trouble. Try not to burn wire insulation, at least not to the point where enough bare wire is exposed to touch some point other than that to which the wire is soldered. Exact placement of wires and exact lengths are of no importance in the power supply. The only objective is a fair degree of neatness. The small Ungar soldering iron recommended by us at the beginning of this manual can be used for all soldering in the power supply. However, if you have a somewhat larger iron or a gun, you may use it, provided its tip is not so large as to be cumbersome. A larger iron, of course, is never to be used on the printed circuits in other parts of this kit.

19. Find the longer of the two red wires coming from the transformer. Pass its bare end through the hole in G3. (This is one of the twisted mounting ears of the capacitor nearest the transformer.) Use the long nosed pliers to twist this wire around the mounting ear to hold it mechanically; then solder. Arrange the wire so that at no point does its insulation touch anything else except the chassis itself. Refer to Fig. 11 to check the correctness of your work.

20. Pass the bare end of the remaining red transformer wire through the hole in terminal R. Twist the wire around the terminal to hold it in place; do *not* solder. Pass the bared end of the green wire which has a yellow tracer line through point W. W is the hole in that part of the mounting foot of the 2-terminal tie point which secures the mounting foot to the insulating body. Using plenty of heat, solder this wire in place. It is a ground wire and this is a method of connecting it to the chassis.

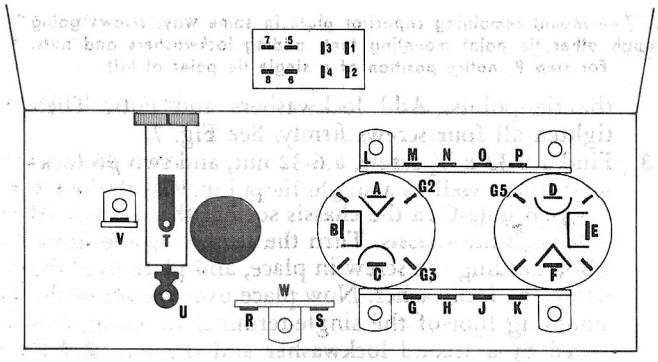

Fig. 10 — This drawing shows all points to which connections will be made, identifying each with a letter. Only bottom and one side of chassis are shown, and perspective has been distorted so you can see connector pins clearly.

21. Pass the bared end of one wire having plain green insulation up through the hole in terminal 6 of the 8-prong socket. Clinch the wire in place and solder it. In the same way solder the remaining plain green wire to socket terminal 4.
22. Pass the bare end of the shorter of the two black transformer wires through the hole in terminal T and secure it mechanically, but do not solder.
23. Lead the remaining black transformer wire under the fuse holder and secure its bared end to point V (the terminal which does *not* touch chassis), but do not solder. Now push all these wires down close to the chassis to get them neatly out of the way.
24. Cut a 3⅛" length of your *thin* bare, uninsulated wire. Push one end through point L (which is a part of the metal mounting foot of a 4-terminal tie point) from the side nearest the chassis wall, then through the hole in G2, and the hole in G5. You will have to use long-nose pliers and some force to pull it through these points. Secure one end of the wire to G5. Pass the other end through the hole in terminal 2 of the 8-prong socket and secure it. Then solder at socket terminal 2, point L, G2, and G5. See that the wire does not touch any other points, including the chassis. Be especially sure that you have applied enough heat to make a good solder joint at point L, as this connection grounds the REVERBATAPE Main Unit to the Power Supply, and a poor connection will cause hum.
25. In all the following wiring steps it is assumed that the chassis is upside down on the table in front of you with the transformer at your left and the two large capacitors at your right (same position as Fig. 10). Cut a length of yellow wire 2⅝" long. Remove about ¼" of insulation from one end and about ⅞" of insulation from the other end. Pass the longer bare end through the hole in capacitor terminal E from left to right. With longnose pliers bend the bare end around and pass it also through the hole in terminal F. Secure the end to terminal F. Solder it to terminals E and F. Secure the other end to tie point terminal O, but do not solder.
26. Cut a 2½" length of yellow wire. Remove insulation from about ⅜" of one end, and about 1" of the other end. Pass the longer bared end through both terminals J and K and secure to terminal K. Do not solder to either J or K. Secure the other end of the wire to capacitor terminal C, but do not solder.
27. Cut 2⅛" of yellow wire. Remove insulation from about ¼" at each end. Secure and solder one end to capacitor terminal C, being careful to solder at the same time the wire already on terminal C. Secure the other end of this wire to tie point terminal N but do not solder.
28. Cut a 2⅞" length of yellow wire. Remove about ¼" of insulation at one end and ⅞" at the other. Secure and solder the short end to capacitor terminal A. Pass the other end through G and H; secure to H, but do not solder.
29. Cut a 1¾" length of yellow wire and remove about ¼" of insulation from each end. Secure but do not solder one end to capacitor terminal B; secure but do not solder the other end to tie point terminal M.
30. Cut a 2½" length of yellow wire and bare each end about ¼". Positioning the wire so that it passes toward your left under the fuseholder, secure and solder one end of this wire to socket terminal 8. Secure but do not solder the other end to terminal V.
31. Cut a 1¾" length of yellow wire and remove about ¼" of insulation from each end. Secure and solder one end to socket terminal 7; secure and solder the other end to point T, being careful to solder also the black wire already there. Now push terminal T down as close to the barrel of fuse holder as possible.
32. Cut a 5" length of yellow wire. Remove 1" of insulation from one end and ¼" from the other end. Pass the longer bared end through tie point terminal P and also through capacitor terminal D. Secure and solder the end to capacitor terminal D. Do not solder to terminal P. Pass the other end of the wire down through socket terminal 5. Secure and solder it to this terminal. Now push the wire back over the top of the socket and along the wall of the chassis, so that it runs from terminal P right back to the chassis wall.
33. Cut a 3½" length of yellow wire and remove about ¼" of insulation from each end. Secure and solder one end to socket terminal 3. Secure but do not solder the other end to tie point terminal O. Push wire against chassis wall.
34. Cut a 2½" piece of yellow wire and remove about ¼" of insulation from each end. Secure and solder one end to socket terminal 1. Secure but do not

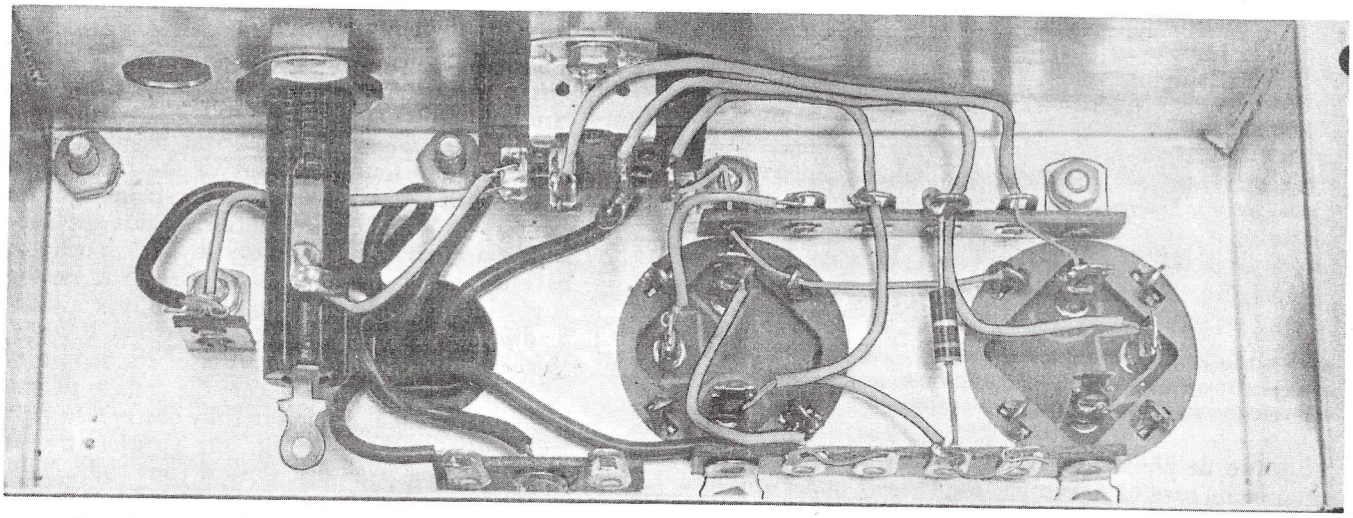

Fig. 11 — Wiring in Power Supply at end of step 36. Examine this photo each time you install a wire, beginning with step 19.

solder the other end to tie point terminal N. Push the wire against the nearby wall of the chassis.

35. Very closely examine all the connections you have made to the socket terminals to be sure that no bare wire or solder is touching any metal part other than the terminal to which it is soldered. If necessary, bend or resolder a wire to maintain a separation of at least 1/16".

36. Locate a 3,300-ohm (orange, orange, red) resistor. Cut down each resistor wire so that only ¾" remains. Pass one wire through tie point terminal O, then the other through tie point terminal J. Position the resistor so it is roughly centered between the

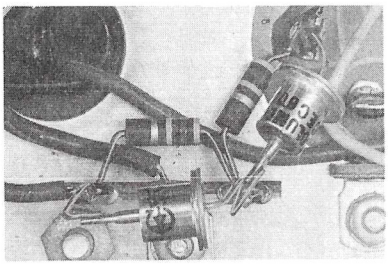

Fig. 12 — Note carefully how resistors and silicon rectifiers are installed in steps 37 through 39. Be sure the two differently shaped ends of each rectifier are in exactly the directions shown in the photo. Don't reverse them!

two tie points and secure each wire to its tie point, being careful not to put the resistor under any tension; leave some slack. Solder each wire to its terminal, very carefully soldering at the same time the two yellow wires previously attached to terminal O, and the yellow wire which passes through terminal J. Inspect the connections closely to see that you actually have soldered each wire. Now compare your work carefully with Fig. 11 to see that all the connections are correctly placed and routed.

37. Find two 470,000-ohm (yellow, purple, yellow) resistors. Bend the wires of one resistor enough so that one wire can be passed through tie point terminal S and the other through capacitor terminal B at the same time. Refer to Fig. 12 to see the position of this resistor. It is fairly close to the chassis, well below the level of the terminals. Secure each wire to its terminal, but do not solder. Bend the wires of the other resistor enough so you can pass one wire through tie point terminal R and the other through terminal S at the same time, the resistor body being on that side of the tie point body which is away from you. See Fig. 12. Secure each wire to its terminal and clip off the excess, but do not solder. This resistor, too, should be fairly close to the chassis, on about the same level as the first.

38. Find the two gold-colored silicon rectifiers. Bend the wires of one rectifier to right angles. Without cutting these wires, secure the end of one to capacitor terminal B and the end of the other to tie point terminal S. Notice carefully in Fig. 12 that the end of the rectifier body which is a large disc is the end whose wire is connected to B, while the wire at the smaller end of the rectifier is connected to S. You *must* observe this polarity. Do not solder the wire connected to S. Solder the wire connected to B, carefully soldering at the same time the yellow wire and the resistor wire already on terminal B. Be careful not to touch any part of the rectifier or a rectifier wire with the iron at any point except at the very end of the wire. Excessive heat applied to a silicon rectifier may destroy it. This is why you have not cut the rectifier wires as short as neatness might indicate; the wire length gives heat a chance to dissipate before reaching the rectifier body.

39. In the same way, bend the wires of the second rectifier to right angles and secure the ends to tie point terminals R and S. Again carefully observe the polarity of the rectifier in Fig. 12; position the end which has the large disc toward your right. Solder

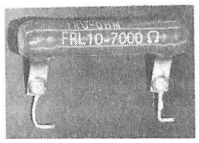

Fig. 13 — Cut off 10-watt resistor wires and bend hooks as shown here. Do this with all three resistors.

this rectifier to terminals R and S, carefully soldering to terminal S also the two resistor wires and the first rectifier wire already attached, and soldering to terminal R also the resistor wire and the red wire previously attached. If you would like to check at this point to see that the rectifiers are in good condition, and if you have an ohmmeter, measure the resistance of one rectifier; then reverse the meter leads and measure again. There should be a very large difference in the two resistance readings. Do the same thing with the other rectifier. This is by

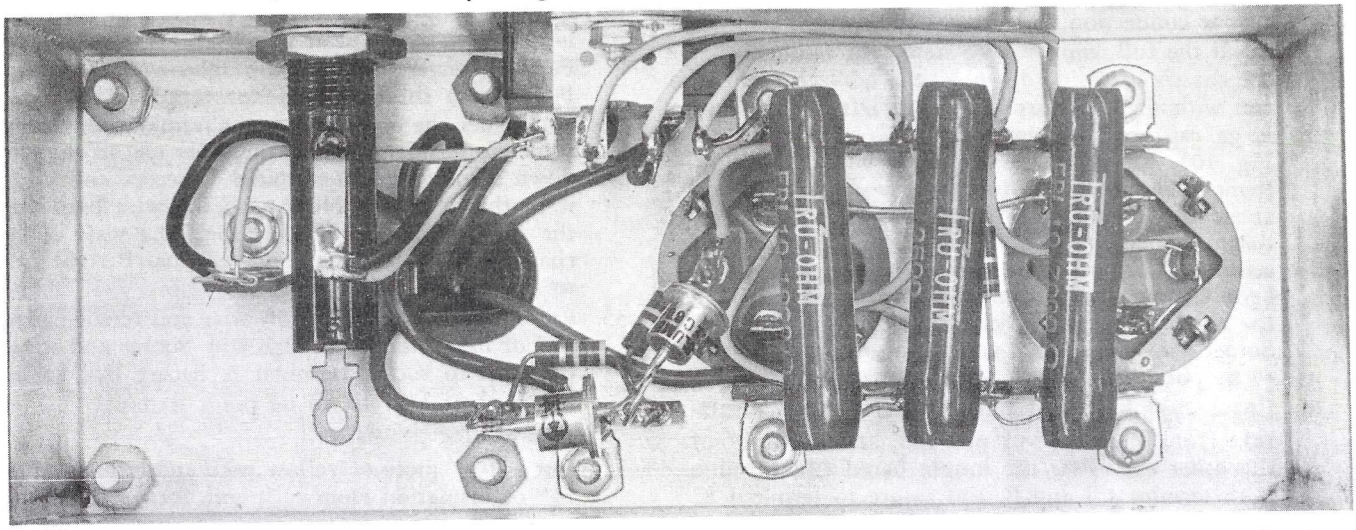

Fig. 14 — Chassis at end of step 43. Notice how large resistors stand straight up and away from tie point terminals to which they are soldered.

no means actually necessary, since the chances of your having ruined a rectifier are almost nil.

40. Find the three large brown power resistors (marked 1,000, 2,500, and 7,000) and straighten out the wires so they jut out at right angles to the bodies of the

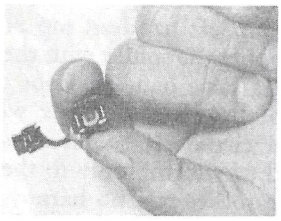

Fig. 15A — Hold strain relief between thumb and forefinger of left hand with opening uppermost.

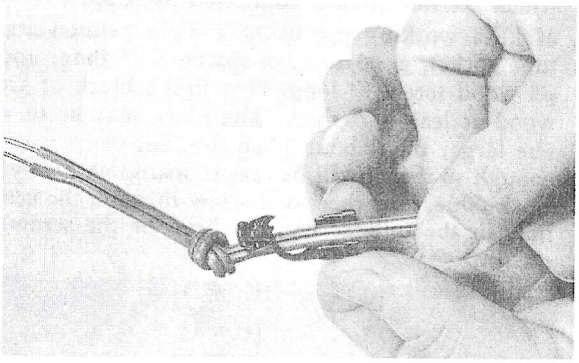

Fig. 15B — Lay cord inside main part of strain relief.

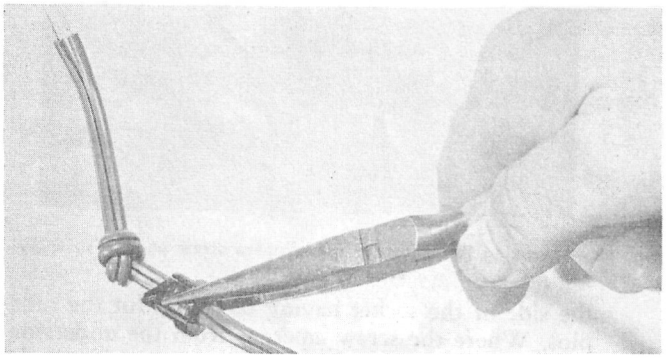

Fig. 15C — Fold over small piece and lay serrated tongue in groove of main piece. Hold two parts together lightly with pliers and draw wire toward you until knot is against plastic.

resistors. Cut off each resistor wire so that the wire which remains extends 7/8" from the cylindrical brown body of the resistor. Then bend a hook in the end of each wire, as indicated in Fig. 13.

41. Examine Fig. 14 to see how the large resistors will be positioned. Pass the hooks at the ends of the resistor marked 1,000 simultaneously through tie point terminals M and G. Use longnose pliers to bend up the hooks and secure the wires to the terminals, so that the resistor stands straight up away from the terminals. Solder to both terminals, carefully soldering also the yellow wire already attached to terminal M and the yellow wire already attached to terminal G.
42. In exactly the same way, secure and solder the resistor marked 2,500 to terminals N and H. At the same time carefully solder also the two yellow wires already on terminal N and the bare wire already on terminal H.
43. In exactly the same way secure and solder the wires of the resistor marked 7,000 to terminals P and K, soldering at the same time the bare wire running through P and the bare wire attached to terminal K. Fig. 14 shows the chassis as wired thus far.
44. Find your a.c. line cord. This is the 2-wire rubber cable with a 2 prong plug at one end and insulation removed from the wires at the other end. Locate also your strain relief. (See identification photo.) At the end of the cord which has no plug, tie a single knot so that 2½" of cable will remain between the knot and the end of the cord. (The bared ends of the wires are included in this 2½".)
45. Hold the strain relief between the thumb and forefinger of your left hand, as shown in Fig. 15A. Now lay the cord in the strain relief, according to Fig. 15B. Next fold over the small piece on the end of the plastic connection and insert its tongue in the slot of the large piece. Squeeze the two together with long nose pliers, as in Fig. 15C. First, hold the pliers loosely enough so you can draw the knot right down to the strain relief. Then tighten. Push the knot and the strain relief into hole O in your chassis from the outside, so that the knot is inside the chassis and the large flange of the strain relief is outside the chassis and touching it. See Fig. 16.
46. Inside the chassis, pull the two wires apart up to the knot. Secure and solder one wire to tie point terminal V, soldering at the same time the yellow and black wires already on terminal V. Secure and solder the other line cord wire to fuse holder terminal U. You have now finished the Power Supply. It is very much worth while to take the time to go over it and inspect every connection in minute detail. See that all solder connections look good — sufficient solder, and solder blended into the metal parts — and that no exposed wire touches any metal part to which it is not actually connected. Inspect especially terminals 3 and 4 of the 8-prong socket to see that no wire or solder is touching the mounting angles of the socket. *WARNING:* Do not plug the power cord into a wall socket, as the power supply is not intended to operate without the remainder of the REVERBATAPE Unit connected to it. Your 1½" ampere fuse was shipped already mounted in the fuse holder. Check this by unscrewing the narrow knob marked "fuse," and then replace it.

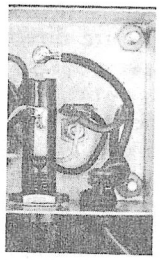

Fig. 16 — Line-cord knot is inside chassis, wires pulled apart and ends soldered to fuse holder end terminal and single tie point.

Now put your Power Supply aside and go on to the rest of the knit.

Module Assembly

47. Almost all the resistors and capacitors in your REVERBATAPE Unit are contained in 8 plug-in modules. You will now construct these modules.
48. Make ready the following items from your kit: The 16 circular printed circuits; 8 printed-circuit tube sockets; 8 #4 tubular spacers 15/16" long; 8 4-40

screws 2⅛" long; 8 4-40 nuts; and 8 9-pin plugs.

49. Examine each plug carefully. See that the top surface of the plastic centerpost is perfectly flat and smooth. Some plugs come from the factory with a little "flash," that is, one or more thin slivers of plastic of irregular shape adhering to the top of the centerpost. Use the end of a knife blade or nail file to chip these little pieces away, leaving the plastic smooth and flat.

50. Notice that 8 of the printed circuits have large center holes, and 8 have small ones. Select one of the printed circuits with a large center hole, and one of the printed-circuit tube sockets. Examine Fig. 17. Hold the printed circuit so the copper side is uppermost; hold the socket in the other hand so that the holes into which tube prongs will later go

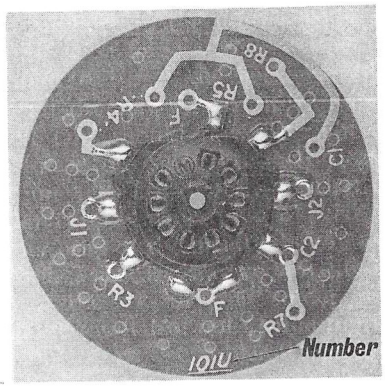

Fig. 17 — A "U" printed circuit with tube socket installed. Note its identification number — 101U.

is uppermost. Lightly press the underside of the socket into the printed circuit center hole, and rotate the socket until the small semicircular indentation in the socket body matches the small semicircular projection at one point in the printed-circuit hole. You will notice that this places each of the nine metal tabs of the socket directly over one of the nine rectangular copper areas which surround the hole. Supporting the underside of the printed circuit with your fingers so it will not crack, use your thumbs to press the socket firmly into the hole and all the way down until it snaps in place. The metal tabs should now be right against the copper. Rotate the socket slightly if necessary so that all nine tabs are directly centered over the 9 rectangular copper areas.

51. Now solder each of the metal tabs to its rectangular copper area. The easy way to do this is to rest a little bit of the end of your solder on the metal tab and place the flat of your soldering iron's chisel tip right on top of the solder. Hold it there until the solder melts and spreads over the entire rectangle. Be sure to use enough solder, but not so much that some of it flows into a nearby hole. There should be a hole right through the center of the tube socket, but sometimes this is blocked by a thin film of plastic left in the molding process. If so, simply punch through the plastic with a pencil, then blow through the hole to remove any particles. Be sure the hole is completely clear. Fig. 17 shows how the top of the printed circuit now looks. Notice that every printed circuit has a number near the edge, underlined. The one in the photograph is 101U. The U printed circuits are the ones with the large holes for the tube sockets, while the ones with the small holes have corresponding numbers followed by the letter L.

52. Install and solder tube sockets of the same type on each of the remaining 7 "U" printed circuits in the same way. If the printed circuit refuses to stand still while you solder it, hold it down with the third finger of your left hand on top of the tube socket, while you apply the solder with the thumb and forefinger of the same hand. Do not try to clean away the spots of brown solder flux which spatter over the printed circuit. If solder runs along a copper line instead of sticking only to the rectangular area of the tube socket tab, no harm is done as long as the copper line is connected to the particular tube-tab rectangle. Be careful, however, not to allow excess solder to connect two points or parts of lines which are not already connected by copper.

53. Make a working jig, using a 9-pin printed-circuit tube socket, a #6 tubular spacer 3/16" long, and a #5 wood screw 1" long. First find a block of scrap wood at least ½" thick. The block may be of any size larger than about 3" square, but make it small enough so that it will be easy to manipulate on your work table. Pass the wood screw through the center hole in the tube socket, the head of the screw on

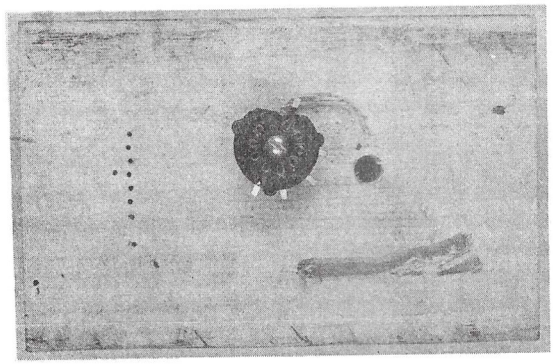

Fig. 18 — Working jig ready for use. Tighten screw enough so socket does not rotate.

the side of the socket having the holes for the tube pins. Where the screw emerges from the underside of the socket, slip the 3/16" spacer over it, then fasten the screw in the wood block. Fig. 18 shows a typical jig ready for use.

54. Plug a 9-pin plug into the socket on your jig; the plastic centerpost will, of course, be up. Place one of the "L" printed circuits having the smaller center hole over the top of the plug so that the centerpost of the plug goes into the hole of the printed circuit. The copper side of the printed circuit is up. Rotate the printed circuit until the 9 short pins of the plug which surround the centerpost go into the 9 small holes around the center of the printed circuit.

55. You will now solder the short plug pins to the small copper circles surrounding the printed-circuit holes through which the pins protrude. As you do this make sure at all times that the bottom surface of the printed circuit is resting squarely on the plug. First solder one pin and inspect to make sure the printed circuit is flat against the plug. Then solder a pin on the opposite side and inspect again. Now solder the remaining pins. Be sure you use plenty of solder, but since the pins are fairly closely spaced be careful not to connect two pins accidentally with

excess solder. The finished job is shown in Fig. 19.

56. In exactly the same way, solder the remaining seven 9-pin plugs to the remaining seven "L" printed circuits. Be sure to inspect each finished job to see that no accidental solder bridges exist between pins. If you have accidentally filled any nearby holes with

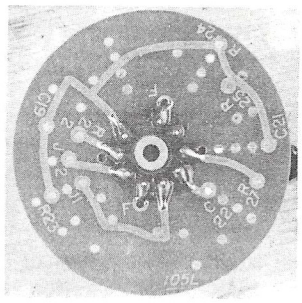

Fig. 19 — An "L" printed circuit with 9-pin plug soldered to it. Inspect carefully to see that solder has not accidentally run between two of the connections.

solder, place the soldering iron on the solder to melt it and twirl an awl or icepick in the hole to clear it as you remove the iron and wait for the solder to harden.

57. Pass a 4-40 x 2⅛" machine screw down through the center hole of the tube socket on printed circuit 101U. The screw head is on top of the socket, that is, on the copper side of the printed circuit. Hold the screw head in place with a finger and pass over the free end of the screw a 1 5/16" tubular spacer. Now place the centerpost of the 9-pin plug on printed circuit 101L over the screw so that the center post of the plug touches the end of the tubular spacer. Hold the assembly upside down so that the bottom of the 9-pin plug faces up. Into the hex-shaped hole on the bottom of the socket drop a 4-40 small nut. Then rotate the socket until the nut is threaded onto the screw end. Do not tighten. Look at Fig. 20. Cut the wire of any ½-watt resistor until the wire is only an inch long. See that both resistor wires are straight and that both, with the

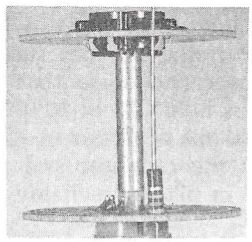

Fig. 20 — The assembled 101 module, with the resistor through the R7 holes. With resistor exactly parallel to the metal spacer, tighten the screw to hold the module pieces together.

body of the resistor, form a straight line. Turn the module assembly right side up, so the copper faces up. Pass the longer wire of the resistor upwards through the hole in printed circuit 101U labelled R7. Rotate the two printed circuits with respect to each other until the hole marked R7 in printed circuit 101L is directly under the R7 hole in 101U. Then drop the lower (short) wire of the resistor in the lower R7 hole. Rotate the two printed circuits so that the two R7 holes are directly aligned, as proved by the fact that when you sight directly at the module from the side the resistor and its wires are directly parallel to the tubular spacer which separates the two printed circuits. Holding the two printed circuits in exactly this position, tighten the long screw firmly to hold the module together. Fig. 20 shows the module as it looks when it is assembled, with the alignment resistor in place. This resistor can now be removed.

58. In exactly the same way, assemble the remaining seven modules. In each case, be sure to use the two printed circuits with the same number, one ending in "U" and the other in "L." Use the resistor in each case to align the two printed circuits so that any two holes in the upper and lower sections having the same designation are in line. You will find that three of the modules are identical, using printed circuits 105U and 105L. Keep in mind that the holes designated by the copper markings are always those surrounded by copper circles, and you should always ignore, both now and in all future operations any holes which are not surrounded by copper. In tightening the screws, it would be almost impossible to tighten them enough to prevent absolutely any possibility of rotation. It is sufficient merely to tighten them so one printed circuit cannot easily rotate with respect to the other. The components you will later solder in place will make them perfectly rigid.

Wiring the Modules

59. Cut up your uninsulated wire into sections 14 to 15 inches long. Straighten each section by clamping one end in a vise, grasping the other end with a pair of pliers, and pulling firmly until the wire actually stretches slightly. If you do not have a vise, have another person help you, each person grasping one end of the wire with pliers. Collect all the straightened pieces neatly and protect them from being bent before use.

60. We will now place jumper wires, resistors, and capacitors on the modules. We will begin with module 105, going into great detail about the exact methods of mounting the components. You will quickly see that the designations in copper on each printed circuit will show you, in future modules, how to mount the components, once you have understood the methods used in module 105. Instructions for the other modules, therefore, will not be so detailed.

61. Plug one of the 105 modules into your jig. Pass an end of one of your straightened bare wires down through one of the holes marked F in 105U, and down through the hole marked F almost directly beneath in 105L. Drop the wire down until it is stopped by the rim of the 9-prong plug. Now solder the wire to the copper circle surrounding each F hole. In all the module wiring, be very careful to use only holes which are surrounded by copper and never holes which are not surrounded by copper. Clip off the excess wire which projects upward from 105U. In exactly the same way, use a bare wire to connect together the remaining F hole in 105U and the one beneath it in 105L, and clip off excess wire above 105U.

62. In exactly the same way, pass a bare wire down through hole J1 in 105U and hole J1 in 105L. This time the lower end of the wire will rest on the wood block which is part of your jig. Be sure to select the correct holes, the ones closest to the designation J1. Solder the wire to both holes and clip off

the excess above 105U. In exactly the same way, connect together holes J2 in the two printed circuits.

63. Select a 100,000-ohm resistor (brown, black, yellow). This resistor will be mounted vertically on the module. One wire of every component which is to be mounted vertically must be clipped short before mounting. Fig. 21 shows you how to do this. Hold the component vertically so that its wires are against the edges of the two printed circuits. The upper end of the body of the component should touch the underside of the upper printed circuit. Clip off the lower wire just above the upper surface of the lower printed circuit, as indicated by the arrowhead labelled "clip here" in Fig. 21. Now pass the longer wire of the 100,000-ohm resistor upward through hole R22 in 105U until the top of the resistor body

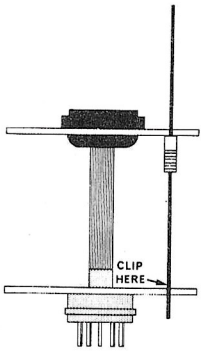

Fig. 21 — How to use a module as a gauge in clipping one wire of each component.

touches the underside of 105U. Then drop the lower wire of the resistor into hole R22 in 105L. Looking at the module from the side, position the resistor body about halfway between the two printed circuits, bending the upper wire slightly, above 105U, to hold it in that position. Fig. 22 shows the module at this point. Solder each resistor wire to its R22 hole, and clip off excess wire above 105U.

64. In exactly the same way, install resistor R25, 1,000 ohms (brown, black, red); R24, 1,000,000 ohms or 1 megohm (brown, black, green); and R27, 100,000 ohms (brown, black, yellow). The R23 holes remain unused at this time. This same procedure will be used to mount all resistors and capacitors which are vertical — those for which similarly marked holes appear in both printed circuits.

65. Some resistors are mounted entirely on one of the printed circuits only, such as R26, for which two holes appear in 105U. Note that the designation "R26" is connected by dots to two holes. Select R26, 2,200,000 ohms (red, red, green), and bend its wires to right angles with the resistor body, as in Fig. 23. Push the ends of the two resistor wires up through the two R26 holes so that the body of the resistor lies against the underside of 105U. Bend the wires outward slightly, above 105U, to hold the resistor in place. Solder both wires to the copper circles surrounding the holes. Then clip off excess wires above 105U.

66. Notice that two holes in 105U are designated by dotted lines leading from the marking "C23." Select C23, a .0022-mfd tubular capacitor, and bend the wires to right angles with the body, as in Fig. 23. Mount C23 just as you did R26. In this case, however, you need not place the body of the capacitor directly against the underside of 105U, since to do this you would have to bend wires already installed. Merely place it as near the underside of 105U as you can comfortably. Bend the wires slightly as

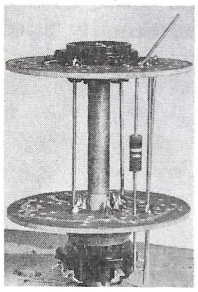

Fig. 22 — A resistor installed before soldering. Position body about halfway between two printed circuits and bend upper wire so it stays there. Then solder to both holes and clip off wire above top.

they emerge above 105U to hold the capacitor in place, and solder both. Then clip off excess wire.

67. Mount capacitor C20 exactly as you did C23, except that C20 may be placed with its body touching the underside of 105U. C20 is a .01-mfd tubular capacitor.

68. Select C21, .01-mfd. Straighten out its wires and hold the capacitor against the side of the module, as in Fig. 21, clipping off the lower wire as indicated in the drawing. (Most of the tubular capacitors have a white ring near one end. Simply ignore this.) Now mount and solder capacitor C21 vertically in its holes, exactly as you mounted the vertical resistors, positioning the capacitor body about halfway between the two printed circuits.

69. Mount C19, a .033-mfd capacitor, in exactly the same way. Since the body of C19 is rather long, and there is little space between its bottom end and 105L, solder the bottom carefully, slipping your soldering iron tip in so as to avoid burning the capacitor, so far as possible. A touch or two of the soldering iron to the capacitor body will not harm it; simply try to minimize this.

70. Select capacitor C22, .1-mfd, *400 volts*. Cut one wire just short enough so you can install the capacitor in the C22 holes, but not shorter than necessary. Position the capacitor so that the short wire just barely enters hole C22 in 105L and bend the upper wire to hold the capacitor in place. Slip the iron in underneath the capacitor and carefully solder the lower wire in place. Inevitably, the iron will touch

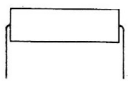

Fig. 23 — How resistor or capacitor wires are bent when both wires will be soldered to one printed circuit.

the capacitor; try to minimize this and do not leave the iron in place longer than necessary to make a good solder joint. Then solder the upper wire.

71. Remove the 105 module from your jig, and clip off all excess wire protruding through holes under 105L and above 105U. Now *examine all solder joints with minute care,* to see that (a) all solder joints look good — fairly shiny, and in accordance with Fig. 3A, and (b) you have not accidentally let solder overflow so as to bridge two points which are not connected by copper. To help you determine this, Fig. 24 shows drawings of the copper patterns on

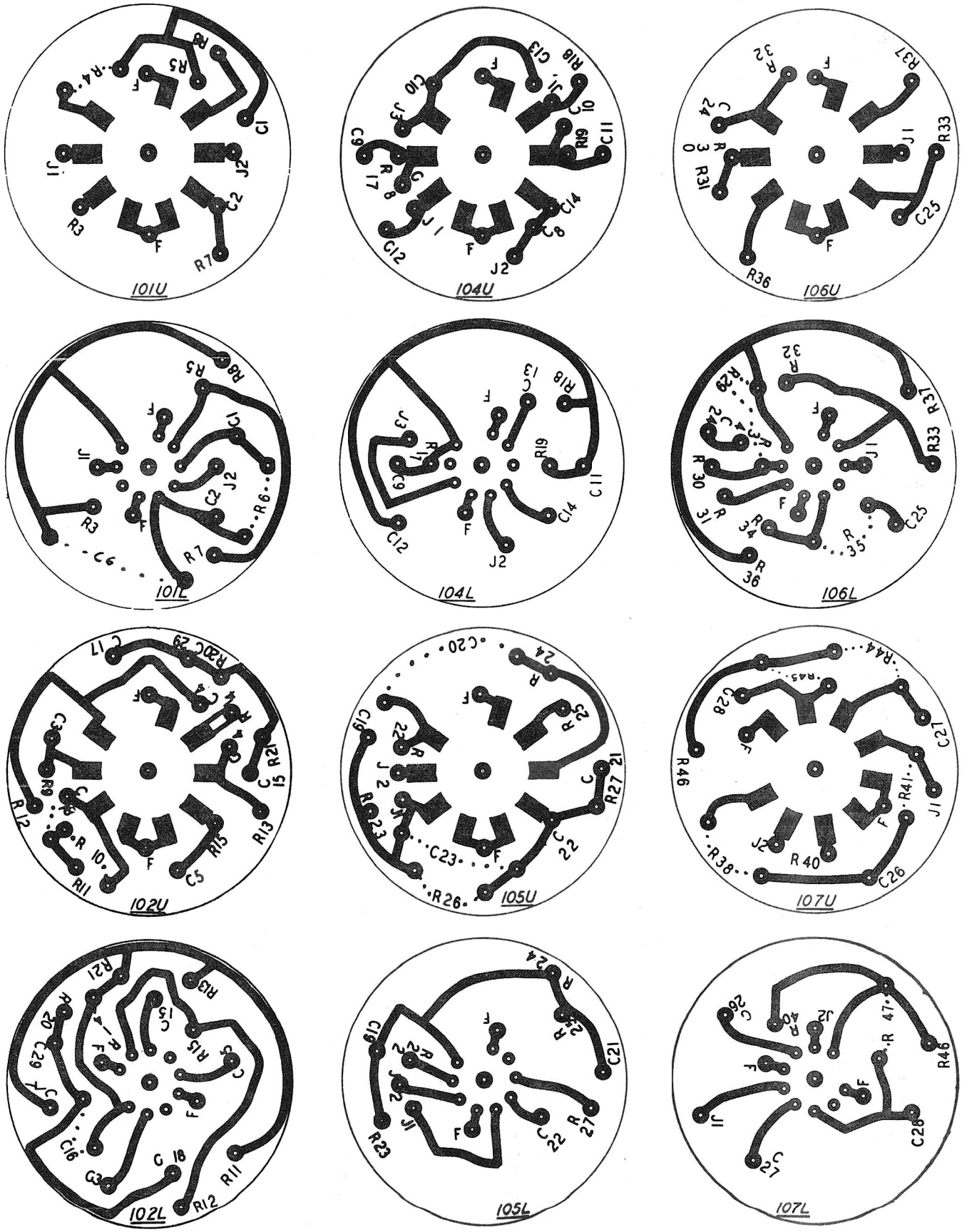

Fig. 24 — Use these drawings of the copper patterns on the printed circuits when you inspect your finished modules, to see that wherever two copper lines or dots are connected by solder, there was copper between them, indicating that the connection is not accidental. The holes in the printed circuits which are not surrounded by copper are not shown here; so you can also use these drawings in case you have any doubt as to which numerals apply to which holes.

all the printed circuits. This completes the module. Notice that one hole marked R23 on each of the printed circuits is still empty. These will be used for a calibration resistor to be installed later.

72. Add components and jumper wires to the remaining two 105 modules, following steps 61 through 71 for each one. In wiring the modules, always use up one

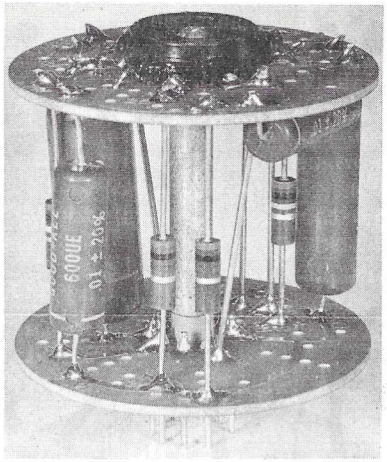

Fig. 25 — A completed 105 module. Examine all connections carefully and clip off all wires above and below printed circuits. Clip off those above upper one as close to solder mounds as possible.

length of straightened bare wire before using the next. Fig. 25 shows a completed 105 module.

73. Plug the 101 module into your jig. Connect the two sets of F holes with bare wires as you did in the 105 module. Connect the J1 holes and the J2 holes in the same way.
74. Bend the wires of resistor R6, 560,000 ohms, (green, blue, yellow) to right angles with the body, as in Fig. 23. Remove the module from the jig and pass the resistor wires upward through the two R6 holes in 101L. Bend the wires apart slightly as they emerge on the copper side of 101L, and solder both; then clip off excess wire. Replace the module in the jig and in exactly the same way install resistor R4, 150,000 ohms (brown, green, yellow) in the two R4 holes in 101U. The resistor body should be against the blank side of 101U.
75. The remaining components of this module are installed in the familiar vertical fashion, in the following order: R5, 27,000 ohms (red, purple, orange); R8, 470 ohms (yellow, purple, brown); C1, .1 mfd, *400 volts;* C2, .0022 mfd; R7, 100,000 ohms (brown, black, yellow); and R3, 1500 ohms (brown, green, red). The two C6 holes, if they exist in your 101L, are not used. Clip off all excess wires above and below the printed circuits. This completes module 101.
76. Plug module 102 into your jig. Connect the two sets of F holes in the usual manner. Find your two .01-mfd *disc* capacitors. Push the wires of one *upward* through the two C4 holes in 102U and solder. Bend the capacitor body as far as possible toward the metal centerpost of the module. Plug the wires of the second capacitor *downward* into the two C16 holes in 102L. Be sure to leave a little bare wire showing above the holes. Solder these wires to the copper. Push the capacitor body as near as possible to the metal centerpost. Bend the wires of resistor R9, 1,000,000 ohms (brown, black, green) to right angles (Fig. 23) and push them *upward* through the two R9 holes in 102U. Be careful to choose the correct holes by noticing that incorrect holes have other designations. Press the resistor against the underside of 102U and solder the wires. In the same way, mount R10, 4700 ohms (yellow, purple, red).
77. Now mount the following components in the usual vertical manner: R15, 22,000 ohms, 1-watt (resistor 9/16" long, red, red, orange); C5, .1 mfd, *400 volts;* R11, 5600 ohms (green, blue, red); C18, .15 mfd, (be especially careful not to touch this capacitor with the soldering iron); R12, 220,000 ohms (red, red, yellow); C3, .0047 mfd; C17, .022 mfd; C29, .01 mfd; R20, 15,000 ohms (brown, green, orange); R14, 1000 ohms, (brown, black, red) — the R14 hole in 102L is just to the right of the R21 hole; R21, 8200 ohms (gray, red, red); C15, .1 mfd, *200 volts;* and R13, 1,000,000 ohms (brown, black, green). After clipping off all excess wires and examining every connection carefully, you have finished with module 102.
78. Plug module 104 into your jig. Cut a 2" length of green wire and remove about 1/4" of insulation from each end. Pass the two ends upward through the two holes marked J1 in 104U, and solder, leaving the insulated portion of the wire traveling underneath the tube socket past one side of the metal centerpost. Bend the wires of C8, .0022 mfd, to right angles (Fig. 23) and pass them upward through the two C8 holes in 104U. *With the capacitor body held against the centerpost of the module,* push it up as far as it will go to the bottom of the tube socket, and solder the wires. In exactly the same way mount C10, .0022 mfd, on the other side of the centerpost. The green J1 wire will be between one of these capacitors and the underside of the tube socket. Both capacitor bodies are as high and as near to the centerpost as they can go. Install R17, 22,000 ohms (red, red, orange), in the usual vertical manner. Now interconnect the two pairs of F holes, the two J2 holes, and the two J3 holes in the usual way with straightened bare wires. Find the two 470-mmf mica capacitors (t in Photo A). Install one in the vertical manner in the C14 holes, and the other in the C13 holes. Position the capacitor bodies down far enough so they are just under the tubular capacitors you have already installed. In soldering these capacitors to the holes in 104L, use

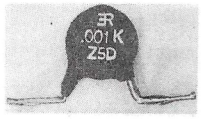

Fig. 26 — Bending the flat "wires" of the .001-mfd disc capacitor in step 78. Tips must be far enough apart so they can touch the solder blobs at the bottom connections of the two mica capacitors, as in Fig. 27. Some of the reddish insulating material may crack off as you bend the wires; this does no harm as long as the disc itself is intact. Melt some solder on the tips.

an unusually large amount of solder so that a large blob is built up at each connection. Find your .001 mfd *disc* capacitor, and bend its wires as shown in Fig. 26. The tips of the wires must be far enough apart so that they can simultaneously touch the lower connections of capacitors 13 and 14. Do not be afraid to bend slightly the sections of the wires which are close to the disc and are covered with red insulating material; if this material cracks off, no harm

is done. Cover the tips of the wires with solder. Refer to Fig. 27. Notice how the .001 disc stands upright on 104L, the tips of its wires embedded in the solder blobs at the lower ends of C13 and C14. To achieve this, use long nose pliers to hold the capacitor by one of its wires and place it approximately in position, the other wire touching one of the solder blobs beneath the mica capacitor. Heat that solder until the tip of the disc capacitor wire sinks into it, then remove the iron and allow the solder to harden without moving anything. This fastens down one end of the disc. Finally, hold down the other disc capacitor wire against the other solder blob under the other disc capacitor, using the pliers

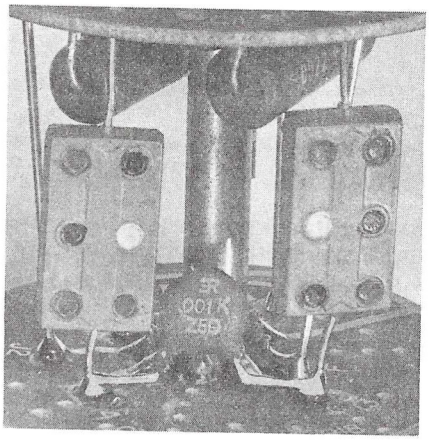

Fig. 27 — Sink the tip of each disc capacitor wire into one of the solder blobs at bottoms of mica capacitors, by holding wire atop blob and heating. Check your work carefully when finished.

or a small screwdriver, and soften *that* solder blob until the capacitor wire sinks into it. Then let that solder blob cool. This fastens down the other end of the disc capacitor. Push the disc slightly toward the centerpost, if necessary, so that it is not directly above the R19 hole.

79. Mount the remaining components in the usual vertical fashion, in the following order: R19, 22,000 ohms (red, red, orange); C11, .01 mfd; C12, .001 mfd; C9, .01 mfd; and R18, 220 ohms (red, red, brown). Clip off all excess wires and examine all connections carefully. This completes module 104.
80. Select your 106 module. Bend the wires of a 100,000-ohm resistor (brown, black, yellow) to right angles with the body as in Fig. 23. Pass the wires upward through the R29 holes in 106L. Notice that one R29 hole is above and to the left of the numerals, as indicated by the dotted line. To find the other R29 hole, follow the long series of dots, ignoring the R34 designation which interrupts the dots. Follow the dots past the R34 numerals to the hole which is close to plug pin 2. Push the resistor against the blank side of 106L, and solder the wires. Then clip off the excess. In the same way, solder a 100,000-ohm resistor (brown, black, yellow) in the two R34 holes; and a 330,000-ohm resistor (orange, orange, yellow) in the R35 holes.
81. Plug the module into your jig, and interconnect the two pairs of F holes and the two J1 holes with straightened bare wires, as usual.
82. Install the remaining components in the usual vertical fashion, in the following order: R31, 560,000 ohms (green, blue, yellow); R30, 470,000 ohms (yellow, purple, yellow); C24, .033 mfd; R32, 100,000 ohms (brown, black, yellow); R37, 2200 ohms (red, red, red); R33, 100,000 ohms (brown, black, yellow); C25, .033 mfd; and R36, 2200 ohms (red, red, red). Clip off all excess wires and examine all connections carefully. This completes module 106.
83. Take up module 107. Bend the wires of a 1,000,000-ohm resistor (brown, black, green) as in Fig. 23 and pass the wires upward through the R47 holes in 107L. Position the body of the resistor against the blank side of 107L, solder, and clip off excess wire.
84. Plug module 107 into your jig. Bend the wires of a 1500-ohm resistor (brown, green, red) to right angles and pass them upward through the R45 holes in 107U, the resistor body against the blank side of 107U. Solder and clip off excess wires. In the same way, mount R44, 470,000 ohms (yellow, purple, yellow); R41, 220,000 ohms (red, red, yellow); and R38, 68,000 ohms (blue, gray, orange).
85. Use straightened bare wires in the usual manner to interconnect the two pairs of F holes, the J1 holes, and the J2 holes.
86. Add the remaining components in the usual vertical manner, in the following order: R46, 10,000 ohms (brown, black, orange); C28, .1 mfd, 200 volts; C27, .01 mfd; R40, 2200 ohms (red, red, red); and C26, .047 mfd, *400 volts*. Clip off all excess wires and examine all connections carefully. This completes module 107.
87. Locate again your three 105 modules. Notice that on 105U between the C20 marking and the F marking above it, there is a little area of clear printed circuit. In this general area, you must mark each module with a number, 1, 2, or 3. Use a marking method which is prominent and visible. India ink is good; an ordinary fountain pen will work; and sometimes a ball point pen will "take." Or you may use white paint with a small brush. Be sure the marking is plain so you can identify which 105 module is number 1, number 2, and number 3.
88. If you have not already done so, unpack your Main Unit. This is the rectangular steel box containing the tape mechanism. On one inside wall of the box you will find a sticker on which is written three resistor values, each identified by a number 1, 2, or 3. In your kit you will find a small envelope which contains three resistors of the values marked inside the Main Unit. Mount resistor #1 in the usual vertical fashion in the R23 holes of 105 module #1. Mount the #2 resistor in the R23 holes of 105 module #2. Mount the #3 resistor in the R23 holes of 105 module #3. This completes your modules.
89. Find the rear cover plate of your REVERBATAPE Unit. This is the flat phenolic plate having 8 large holes numbered V1 through V8 in large white letters, as well as other lettering. Mark the V4 hole "1," V5 hole "2," and the V6 hole "3," using a permanent marking method.

Components on Chassis

90. Carefully examine Fig. 28. Place your flat steel chassis on the table in the same position as the one shown in the photograph. You are now looking at the *underside* of the chassis, the surface on which

the undersides of the tube sockets appear and on which most of the work will be done. The other face, on which the tops of the tube sockets will show (the parts with the holes into which the module plug pins will go) is the *topside*. If necessary to help

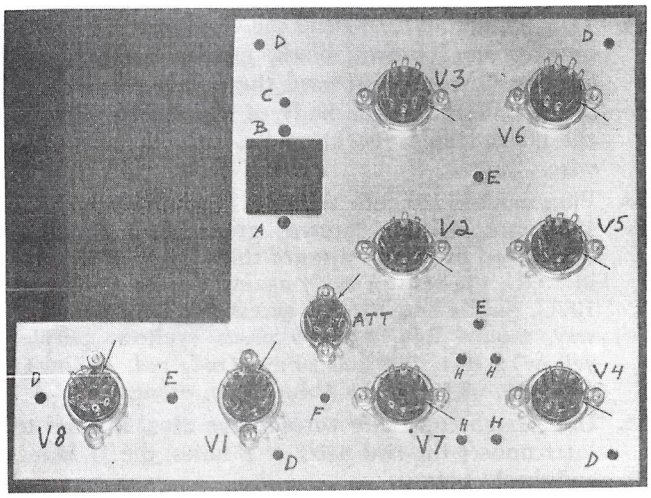

Fig. 28 — Underside of flat chassis. Position it on the table just as you see it here, rectangular corner cutout at your upper left. Small arrow at each socket points to location of blank space between first and last pins. After mounting the 9 sockets, mark chassis plainly with V1 through V8 designations, ATT (for the 7-pin socket), and letters for the unused holes.

you remember which is the rear and which the front face, write the word "bottom" on the surface facing up, corresponding with the photograph, and then turn the chassis over temporarily and write the word "top" on the other side.

91. First mount the eight 9-pin tube sockets, which are designated in the photograph V1 through V8. To mount a tube socket place it in the large hole, with the pins toward you. Notice that the metal mounting saddle of the socket is on the rear face of the chassis. It is very important that you mount the tube sockets on the correct face of the chassis; examine Fig. 28 carefully and be sure you do likewise. Rotate the tube socket so that the two small holes in the mounting saddle are over the two corresponding holes in the chassis. Notice that this can be done with the socket in two possible positions. Only one position is correct. You can see that there is a space between pins 1 and 9 (the pin numbers are marked on the socket). Turn the tube socket in each case so that this space is at the point indicated by the arrows which have been added to the photograph. This, too, is extremely important. To fasten the socket in place, pass a 4-40 x 1/4 screw through the hole in the chassis (with the head of the screw on the *top* face) and through the hole in the tube socket mounting saddle. Over the screw place a #4 lockwasher, followed by a *large* 4-40 nut. Do the same for the other socket mounting hole. Then tighten both screws firmly. Mount all of the 9-pin sockets in this same way, being very careful about which way each socket is turned.

92. Now mount the 7-pin socket in the hole marked in Fig. 28 "ATT." Here, too, it is important that the space between pins 1 and 7 be correctly placed, and this is indicated by an arrow in the photograph. Use the same screws, lockwashers, and nuts.

93. Use a plainly visible, permanent marking method to mark V1 through V8 near the tube sockets, exactly as shown in Fig. 28. Mark the 7-pin socket "ATT." Then mark each of the remaining holes as shown in the photograph. Be very sure you have found the correct holes. The large square hole is not marked.

94. Examine Fig. 29. Bend pin 9 of socket V4 slightly toward the outside of the socket. Use your fingers to do this, making the bend right at the point where the pin emerges from the plastic material. Grasp the end of the pin with pliers, preferably a pair whose tip is at least as wide as the pin. Allow the

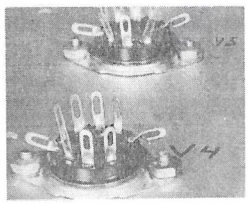

Fig. 29 — Notice how pins 4 and 9 are bent and twisted, so that a single piece of stiff wire can go through corresponding pins on V4, V5, and V6, on V3, V2, and V7, and on V8 and V1.

pliers to grip the pin from its tip down to the end of the slot nearest the plastic, but not closer than that to the plastic. Give the pin a full clockwise quarter twist. Then, with your fingers, bend the twisted pin down until it is nearly horizontal, making sure, however, that it is well clear of the nearby socket mounting screw. Do the same thing with pin 4. Fig. 29 shows the result. The point is to allow a stiff wire to be passed through the pin, while the wire remains parallel to the chassis. In exactly this same way twist and bend over pins 9 and 4 of all the 9-pin sockets.

95. Fig. 30 shows the finished results of steps 95 through 100. Refer to it frequently. Pass a piece of straight-

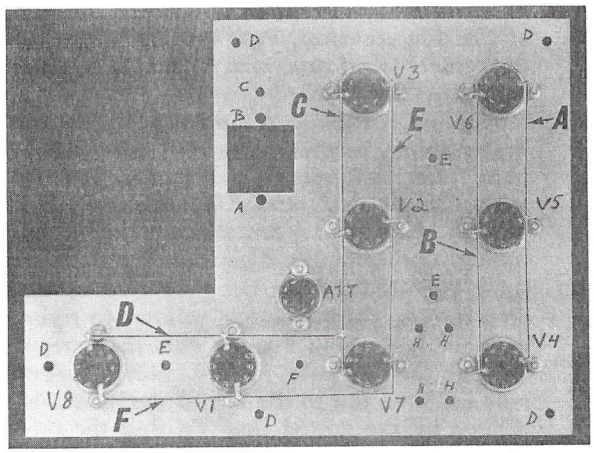

Fig. 30 — The first six straight wires installed after step 100.

ened bare wire through pin 9 of V6, then through pin 9 of V5, and finally pin 9 of V4. This is wire A in Fig. 30. Solder securely to all three pins, being sure to apply sufficient heat for a good joint. Then clip off all excess wire above V6 and below V4.

96. In the same way, pass a wire through pin 4 of V6, V5, and V4. Solder to all three pins and clip off the excess. This is wire B in Fig. 30.

97. Pass a bare wire through pins 4 of V3, V2, and V7. Solder at V7 and V2, but do not solder at V3. This is wire C in Fig. 30. Clip off the excess below V7, and leave about 1/16" of wire protruding upward through pin 4 of V3.

98. Now install wire D. Pass a bare wire through pin 9 of V8 and pin 9 of V1, and all the way over to wire C. Bend a hook in the end of the wire and hook it over wire C. Clamp the hook tight on wire C and solder wire D to wire C. Then solder wire D to each of the socket pins through which it passes, and clip off excess wire to the left of V8.
99. Pass a wire downward through pin 9 of V3, V2, and V7. Solder to pin 9 of V2 only. This is wire E. Without soldering, leave about 1/16" of wire protruding below pin 9 of V7 and above pin 9 of V3, and clip off the excess.
100. Last, install wire F. Pass a straight wire through pin 4 of V8, pin 4 of V1, and over to the right side of V7. At V7 bend the wire to right angles, leaving sufficient length past the bend so that the end of the wire can go through pin 9 of V7, which is already occupied by the lower end of wire E. Make the bend neat and square, as shown in Fig. 30. Now solder the ends of wires E and F to pin 9 of V7, and solder wire F to the V8 and V1 pins through which it passes, clipping off the excess to the left of V8. Examine the six wires you have just installed, comparing your work closely to Fig. 30. Note that pins 4 and 9 of V3 remain unsoldered, but all other points are soldered. See that at each connection there is sufficient solder, and that the solder, the tube pin, and the wire have been heated enough so that the solder blends perfectly into each.

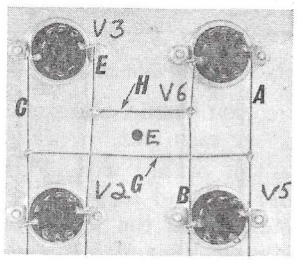

Fig. 31 — Installing wires G and H. Be sure wire G cannot touch wires B or E or the chassis.

101. Fig. 31 shows wires G and H. Cut a 1 5/8" length of bare wire and make a small hook at each end. Notice in Fig. 31 that wire H is connected to wires B and E and is about 3/8" above hole E. Hook the ends of the wire you have cut over wires B and E at the position shown in Fig. 31, clinch the hooks, and solder.
102. Cut a 3 3/4" length of bare wire and make a hook in each end. Notice the location of wire G in Fig. 31 —about 3/8" below hole E. This wire will connect to wires A and C, and will run *underneath* wires B and E — near the chassis. First hook one end over wire A, clinch the hook, and solder. Now, if you have cut the wire to the right length, it will be too long to go directly to wire C, so bend it down to within about 1/8" of the chassis so it passes under wires B and E without touching them, and then hook the other end to wire C and solder it. Carefully arrange wire G so it touches neither the chassis nor other wires.

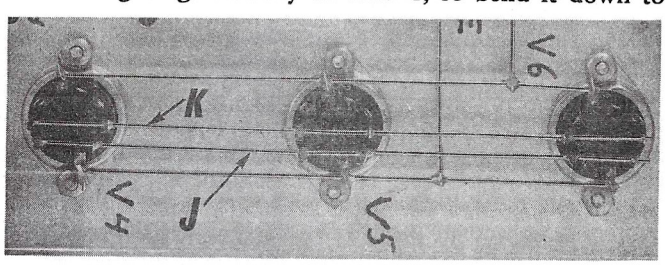

Fig. 32 — Wires J and K pass through two pins on each socket. Don't let them touch any other wires.

103. Refer now to Fig. 32. Install wire J, which passes through pins 1 and 8 of V4, V5, and V6. To ease the passage of this wire, twist the pins slightly, but do not bend them outward. Solder at five pins, but do not solder to pin 8 of V6. Clip off excess wire below V4 and leave about 1/16" of wire above V6.

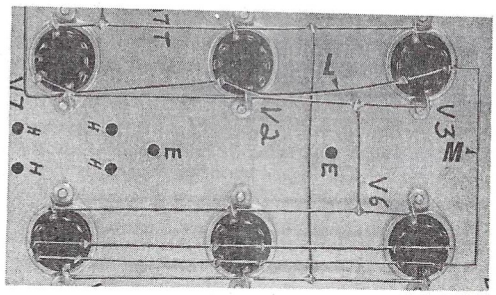

Fig. 33 — Note bends in wire L, which prevents it from touching any socket pins or wires except right ones.

104. Install wire K, passing it through pins 2 and 7 of V4, V5, and V6. Solder to all pins except pin 7 of V6. Clip off excess wire below V4 and leave about 1/16" of wire above V6.
105. Refer next to Fig. 33. Install wire L as follows. Pass a piece of bare wire first through pin 7, then through pin 1 of V3. Pass the same end next through pin 1 of V2, and then through pin 1 of V7. If necessary, slightly twist pin 1 of V2 and V7 for ease of passage. The wire will touch the side of pin 8 of V2 and V7. Solder at pin 1 of V7 only. At the point where wire L touches the side of pin 8 of V7, grasp the wire with the end of a pair of long-nose pliers and pull sharply in the direction of V4. The resulting bend can be seen in Fig. 33. This takes the wire out of contact with pin 8 of V7; make sure it also remains high enough off the chassis so it does not touch pin 9. Now solder to pin 1 of V2. Then grasp the wire where it touches the side of pin 8 of V2 with long-nose pliers, and pull sharply in the direction of V5, making another bend so the wire cannot touch pin 8 of V2. Last, solder the wire to pin 1 of V3, but not to pin 7 of V3. Clip off excess wire below V7 and leave about 1/16" of wire above pin 7 of V3.
106. Bend a piece of bare wire to the shape and dimensions shown in Fig. 34. This is wire M. Notice wire M in Fig. 33. Insert the ends of the bent wire into pin 8 of V6 and pin 7 of V3 just far enough so the wire will not fall out. Then solder them to the pins, soldering also the straight wires already in those pins.

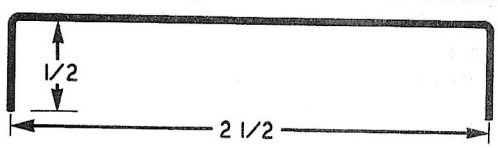

Fig. 34 — Bending and cutting wire M before installation.

107. Examine Fig. 35, which shows the control socket mounted and the last bare ground wires connected. The control socket is a 7-pin tube socket which has no metal mounting saddle (p in Photo A). Bend all the pins of the control socket outward and flat,

as in Fig. 35. You will need the #6 self-tapping screw 7/8" long (a in Photo B) and a tubular spacer 17/32" long. Pass the screw through hole F in the chassis with the head of the screw on the *top* surface — the surface which has no wiring on it. On the underside of the chassis place the spacer over the

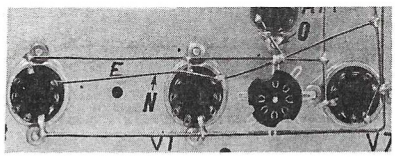

Fig. 35 — Control socket (second from right) attached to chassis. Be sure to turn it before tightening so pins point as shown. Wire N must not touch pin 9 of V1.

screw. Place the hole in the center of the socket over the end of the screw. Notice that the connection pins of this socket are near the chassis, while the top of the socket is facing away from it. Use a 1/4" nutdriver (or pair of pliers) to turn the screw into the plastic of the socket; the screw will cut its own threads in the plastic. When the screw is almost, but not quite, tight, examine Fig. 35 carefully to see the position of the control socket. Since the seven pins do not fill the entire circle, there is the usual space between the first and the last. Note that the two pins on either side of the space are facing the 9 o'clock and 12 o'clock positions respectively. Hold the socket in this position while you tighten the screw. Tighten the screw firmly but not with great force, as this could strip the threads in the plastic. The socket will later be held from turning by the ground wire which you will connect to it.

108. Fig. 36 shows you the numbering of the terminals on the control socket you have just installed. Notice that as you look at the chassis from the usual posi-

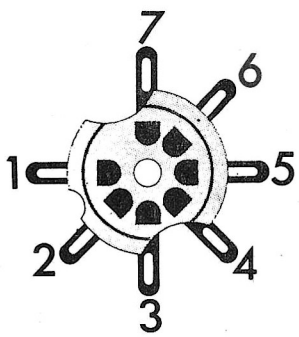

Fig. 36 — Drawing shows numbering of control socket pins after installation. They run counterclockwise because you are facing top of socket.

tion, these numbers run counterclockwise, while on all the other sockets, since they are facing the other way, the numbers run clockwise and may be read from the embossed numerals on the sockets themselves.

109. Look at Fig. 35. Install wire N. Pass a piece of straightened bare wire from left to right through pin 1 of V8, pin 1 of V1, and over to wire L. The wire will touch the side of pin 8 of V1. Bend a small hook in the end and attach it firmly to wire L at a point such that the wire will pass directly under the tip of control socket pin 7. Solder wire N to wire L. Solder control socket pin 7 to wire N. Solder pin 1 of V1. At the point where wire N touches the side of pin 8 of V1, grasp it with long nose-pliers and pull sharply toward the upper edge of the chassis, thus preventing contact between the wire and pin 8 or 9. Now solder at pin 1 of V8. Clip off excess wire. Examine the connection at pin 7 of the control socket to see that it does not touch wire D.

110. On the ATT (attenuator) socket twist pin 5 a quarter turn clockwise and pin 4 a quarter turn counterclockwise. Pass a straight wire downward through both these pins and hook the end around wire N near the point where it connects to control socket pin 7. This is wire O; see Fig. 35. Solder at pins 4 and 5 of the ATT socket and at the connection to wire N. Again examine the latter point to see that nothing can touch wire D. If things are too close, push wire D down closer to the chassis. Clip off excess wire. Check with Fig. 35 to see that your work is correct.

111. You will now install colored wires. The first group is shown in Fig. 37. In the following instructions, when you are told to cut a certain length of insu-

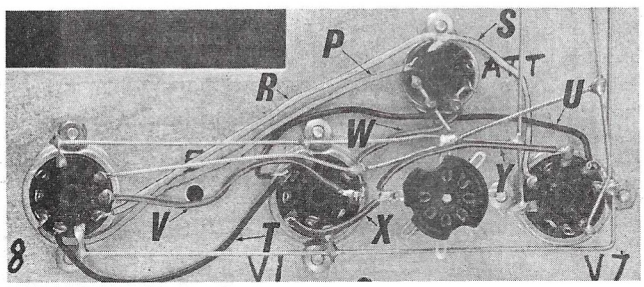

Fig. 37 — The first group of colored wires (steps 111 through 117).

lated wire, you should also remove insulation from about 1/4" at each end.

112. Cut 4 1/2" of orange wire. This is wire P. Secure and solder one end to pin 6 of V8. Pass the wire under and around the socket and under the bare wires between V8 and V1, and secure and solder the other end to pin 6 of the ATT socket.

113. Cut two pieces of yellow wire, one 4" and the other 2 1/2". Secure and solder one end of each wire to pin 7 of the ATT socket. The longer wire is R. Lead its other end to pin 3 of V8 (under the bare wires); secure and solder. The shorter wire is S. Lead it around the socket and under the bare wires to pin 5 of V7. Secure and solder.

114. Cut two pieces of black wire (this is the thin black wire, not the thick cable, which is shielded and which you will use later), one 3 1/4" and the other 4 1/2". Secure and solder one end of each wire to pin 8 of V1. The shorter wire is T. Run the other end under the bare wire to pin 5 of V8. Secure and solder. The longer wire is U. Run it upward, under the bare wires, around the top of the V1 socket to the right, under all the bare wires, and secure it to pin 8 of V7. Do not solder.

115. Cut two pieces of green wire, one 3" and the other 2 1/4". On the shorter piece, remove 1/4" of insulation from one end but at the other end remove 3/8" of insulation. The longer piece is V. Secure one end of V to pin 2 of V1, letting the wire run to the left, right over V1. The shorter piece is W. Secure the end of W with 1/4" of bare wire to pin 2 of V1, the other end of the wire running under the bare wires upward and toward the right side of the ATT socket. Solder both wires to pin 2 of V1. Solder V to pin 2 of V8, and then see that it runs between pins 8 and

9 of V1, not between 7 and 8. Do not let it cover the E hole. Pass the other end of W through both pins 3 and 2 of the ATT socket, twisting the pins as necessary to allow easy passage. Solder to both pins.

116. Cut two pieces of brown wire, one 1⅜" and the other 2¼". Secure and solder one end of each piece to pin 1 of the control socket (see Fig. 36). Run the shorter piece, X, directly to pin 6 of V1; secure and solder. Lead the longer wire, Y, up and around the socket to the right, to pin 7 of V7; secure and solder.

117. Carefully examine all wires and connections to see that (a) all the connections and runs agree with Fig. 37, and (b) all solder connections are well made. Be very careful to see that nothing touches anything else so as to cause an accidental connection. Where necessary to achieve this, bend tube pins and wires, including the bare ones.

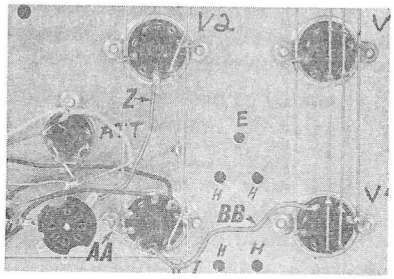

Fig. 38 — Wires AA, BB, and Z installed (steps 118 through 120).

118. Look at Fig. 38. Cut a 2¼" length of red wire. Connect and solder this wire, which is wire Z, directly between pin 2 of V2 and pin 6 of the control socket.

119. Twist pin 3 of V7 a quarter turn and pass a piece of bare wire (wire AA in Fig. 38) through it, over to pin 5 of the control socket. At this point make a small right angle bend in the wire and pass it down through pin 5 of the control socket. Secure and solder the wire to control socket pin 5; then solder to pin 3 of V7 and clip off the excess. Examine it closely to see that it does not touch pin 4 of V7; if it does, bend wire or pin as necessary.

120. Cut a 3" piece of orange wire. Solder one end of this wire, which is BB, to pin 2 of V7, and the other to pin 6 of V4. Route it as shown in Fig. 38.

121. Locate your double phono jack and your solid-conductor shielded cable. (This is the single shielded cable with a *brown* outer jacket.) Cut a 7½" length of the cable. Look at Fig. 39. At one end remove

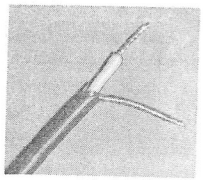

Fig. 39 — How to strip the end of a single-conductor shielded cable. Select the cable having either solid or stranded center conductor, according to instructions. When using stranded wire, twist the strands tight; always do this with the shield conductor.

about ½" of the thin brown outer plastic cover. The best way to do this is to slit the plastic lengthwise for the required distance with a *light touch* of a razor blade, being careful not to press hard enough to damage the shielding inside the jacket. Then split the plastic, peel it away, and clip it off. Now unwind the spiral shielding from around the exposed length of insulated innerconductor, and twist the shield wires together tightly to form a second conductor. Finally, remove about ¼" of insulation from the end of the innerconductor. The final result is shown in Fig. 39.

122. Examine Fig. 40 carefully. As SA in the photo indicates, connect and solder the inner conductor of

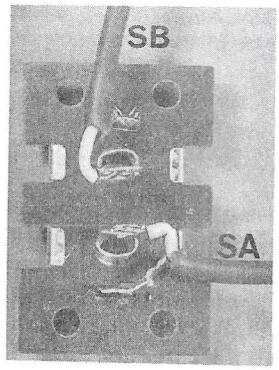

Fig. 40 — How the two shielded cables are wired to the double phono jack. Notice that shield wires are soldered quite close to body of cable, so that if cable is moved around, shield cannot touch the wrong terminal. The cables must come off the jack assembly in the directions shown.

the shielded wire to one of the longer terminals of the double jack. Be sure that the terminals and the wire are arranged as shown for cable SA in the photo. Then connect the twisted shield wires to the short terminal as indicated. Finally, bare the other end of this shielded cable just as you did the first end (Fig. 39).

123. Cut a 3⅝" length of the brown shielded cable, and prepare both ends just as you did the first piece. Examine Fig. 40, and position and solder one end of this cable, which is cable SB in the photo. The center conductor goes to the remaining long terminal and the shield wires to the remaining short terminal.

124. Find 4 tubular spacers ⅝" long, 4 6-32 machine screws 1" long, 4 6-32 nuts and 4 #6 lockwashers. Mount the double jack on the chassis, in the four H holes spacing it from the chassis with the ⅝" spacers. The side of the double jack assembly to which the wires are connected goes nearest to the chassis. Refer to Fig. 41. Wire BB (Fig. 38) should pass between the two long terminals of the double jack. The screw heads are facing you, the lockwashers and nuts on the unwired side of the chassis. Tighten all of them firmly. Note carefully that the double jack should be positioned so that the short wire coming out of one end points in the direction of V3 and V6, while the long wire coming out of one side points to V1 and V8.

125. Attach a 13/16" threaded tubular spacer to the chassis at each of the 5 D holes, using a 6-32 x ¼ screw and lockwasher. The spacer goes on the wired side of the chassis, with the screw head and lockwasher on the unwired side. First tighten all five by hand, then tighten firmly by rotating the spacers with gas pliers.

126. See Fig. 41. Pass the shorter shielded wire from the double jack (SB) under the bare wires and solder the end of the inner conductor to pin 1 of the ATT socket. Solder the shield wire to the bare wire which is attached to control socket pin 7 and

travels diagonally. See that the shield wire does not touch anything other than the bare wire to which it is connected. Watch for wild strands.

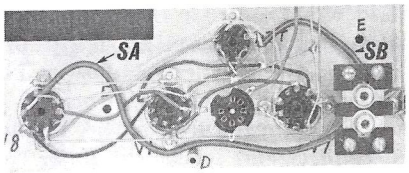

Fig. 41 — Double jack mounted on chassis, with spacers between chassis and jacks. Note where SA and SB wires are routed and connected.

127. Route the longer of the two shielded wires (SA) as shown in Fig. 41. It goes straight out to your left, then upward, under all bare wires, between V1 and V8. Above V8 it makes a loop and the inner conductor is soldered to pin 7 of V8. Wrap the end of the shield wire around the bare wire which is connected to pin 1 of V8, and solder. Again look carefully for wild strands of shield wire.

128. Find a .022-mfd tubular capacitor. Cut one of its wires to a length of 1/4" and bend a small hook in the end. Cut the other wire to a length of 1". Refer to Fig. 42. Hook the short wire of the capacitor to terminal 2 of the control socket; clinch and solder. See that the capacitor is in the position indicated by Fig. 42. Bend the other wire around in a loop and pass it through pin 7 of V1. Secure and solder.

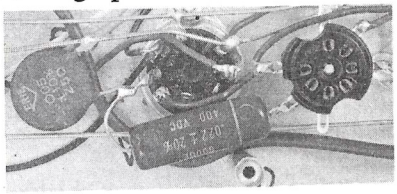

Fig. 42 — Be careful to connect the two capacitors to the terminals specified and position them as shown in this photo.

129. Notice the position of the .005-mfd disc capacitor in Fig. 42. (Its body is parallel to the chassis.) One of its wires is connected to the wire of the .022-mfd capacitor which goes to pin 7 of V1, and the other is connected to the bare wire which goes to pin 1 of V8. Bend the wires of the .005-mfd capacitor and wrap them around the other two wires as shown, then solder. When you are finished, be sure that the .022-mfd capacitor body is pushed as close to the bare wire under it as possible, so that no part of it is as high as the unfastened end of the threaded tubular spacer in the nearby D hole.

130. Cut an 8 3/4" length of brown (solid-conductor) shielded wire. Prepare both ends as in Fig. 39. At one end, however, clip off the shield wires entirely, as close as possible to the outer insulation so that no shield wire will show, so far as possible. To be quite sure that the shield wires are covered, wind a small strip of any sort of tape around the end of the outer insulation. Refer to Fig. 43 and wire SC. Just above V5, pass the end of the cable which *does* have shield wire from right to left under the bare wires and connect and solder the inner conductor to pin 6 of V5. Wrap the shield wire around wire J (the one which passes through pins 1 and 8 of V4, V5, and V6 — see Fig. 32) and solder it. Put enough solder on the shield wire to stiffen it so that even when the cable is moved, the shield wire cannot come in contact with any other wires, especially the bare wire which passes through pins 2 and 7. Now run cable SC as indicated in Fig. 43 and solder it to pin 3 of the control socket. If the cable is a trifle too long, bend it as necessary to be sure that it does not run outside the boundaries of the chassis.

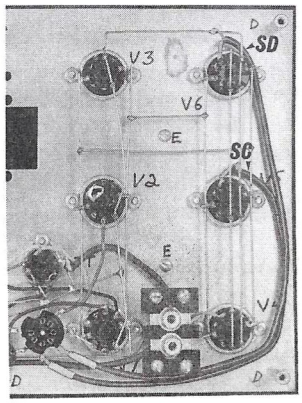

Fig. 43 — How shielded cables SC and SD are routed. When connecting the shield wire at the V5 and V6 ends of these cables, do so as near as possible to body of cable so shield wire cannot touch other wires if cables are moved. However, never hold iron so close to body of cable that it can melt insulation of inner conductor.

131. Cut a 10 1/2" length of the brown shielded wire, and prepare both ends in exactly the same way as in step 130. This is wire SD; refer to Fig. 43. At the end with the shield wire, solder the inner conductor to pin 6 of V6. Wrap the shield wire around wire M (the bare wire which runs from V3 to V6 — see Fig. 33) and solder. Route cable SD as shown in Fig. 43, and solder the other end to pin 4 of the control socket.

132. Pass a 6-32 x 2 3/4 machine screw through one of the E holes with the screw head on the *wired* side of the chassis. Over the screw on the unwired side place a #6 lockwasher and a 6-32 nut. Tighten the screw firmly. Do the same in each of the remaining two E holes. To get at the E hole which is under the .005-mfd disc capacitor, bend the capacitor up temporarily, and then push it down flat again after the screw has been tightened. Be careful not to catch any wires under screw heads. In all future operations you may use these screws as "legs" on which to stand the chassis.

133. Locate your oscillator transformer (rectangular can). The body of the transformer will go on the unwired side of the chassis. See Fig. 44. Place it in position over the square hole with the two threaded mounting lugs projecting upward through holes A and B, with the side of the transformer having three term-

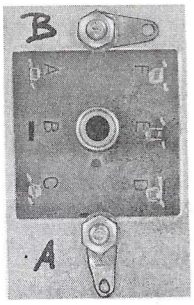

Fig. 44 — The mounted oscillator transformer can. See that it is turned so that end with 3 terminals is toward V2 and V3, and that no terminals can touch the edge of the chassis cutout. When you tighten screws, point the two solder lugs in directions shown, then bend up their ends.

inals in the direction of V2 and V3. Place a #6 lockwasher over each of the threaded mounting lugs as they emerge upward from holes A and B. Next add a solder lug over each mounting lug. Then add two 6-32 nuts, running each nut down only far enough to hold the transformer from falling out. Notice the position of the solder lug which is over hole A in Fig. 44. The small end, with the small hole, is pointing toward the bottom of the chassis. Hold the lug in this position and tighten the nut. As you tighten the nut notice that the mounting holes A and B are slightly larger than the threaded lugs, and the transformer can thus be moved around somewhat. Position the transformer so that its five connection lugs are about equally distant from the left and right borders of the square hole. Tighten the nut firmly, but remember that it is attached to the relatively soft aluminum can, from which it could be torn loose by excessive strength. Tighten the other nut in the same way, holding the solder lug above hole B so that its small end points directly to the right, as in Fig. 44. After everything is in position, according to Fig. 44, use the tip of a screwdriver blade to pry up the small ends of

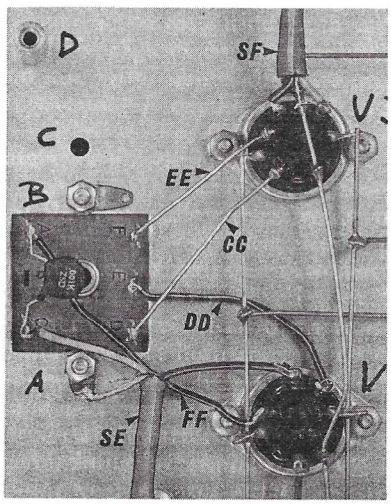

Fig. 45 — Wires and cables connected to the oscillator transformer (steps 134 through 140).

the two solder lugs so that wires can be easily passed through the small holes.

134. Cut a 2½" length of ordinary brown wire and remove about ¼" of insulation from each end. This is wire DD in Fig. 45. Solder one end to pin 8 of V2. Run the wire, under the bare wires, directly over to terminal E of the transformer. Secure to terminal E, but do not solder.

135. Pass bare wire CC through pin 3 of V3 and transformer terminal D, twisting terminal D slightly counterclockwise to allow the wire to go through it. Solder at pin 3 of V3. Then, at the point where wire CC crosses the bare wire connected to pin 4 of V3, lift wire CC so it is at least ⅛" above the other. Solder to terminal D of the transformer and clip off the excess at both ends.

136. In the same way, pass bare wire EE through pin 5 of V3 and terminal F of the transformer, twisting these terminals slightly as necessary for free passage of the wire. Solder to terminal 5 of V3. Lift wire EE at the point where it crosses the bare wire connected to pin 4, and be sure to give plenty of clearance between the two. Now solder at transformer terminal F, and clip off excess at both ends.

137. Find your double shielded cable. This is grey, with two insulated wires inside it, a shield surrounding the two wires. Cut a 7½" length. Remove the outer grey insulation for a distance of 1¼" at one end, being very careful not to damage the shielding by cutting too deep when you slit the insulation. Unwind the spiral shield and twist the strands together to form a wire. Remove about ¼" of insulation from the end of each of the inner wires. Prepare the other end of this cable in the same way, except that you should cut off only about ½" of the outer grey insulation, and you should cut off all shield wires. Remove only about ⅛" of insulation from the end of each of the inner wires. At this end of the cable solder one of the small magnetic head clips to each wire, using the small hole in one end of the clip. *Do not get any solder inside the folded-over section of the clip.* In this operation, it is helpful first to tin each of the bare wires at the ends of the inner conductors by applying a little solder with the soldering iron. This will stiffen the wires and keep the strands together so that you can easily bend a hook in them to hold them firmly to the magnetic head clips before soldering. See cable SE in Fig. 45. Secure and solder the yellow wire at the end having the shield wire to terminal C of the transformer. Solder the green wire to pin 7 of V2. Examine the connection to pin 7 of V2 to be sure that when the cable is moved no uninsulated wire can touch anything else. Now pass the shield wire up through the small hole in the solder lug over hole A, drawing the wire through until it is just long enough and there is no slack. Solder to the lug. Clip off excess shield wire.

138. Cut a 3" piece of black wire (FF in Fig. 45). Solder one end to pin 5 of V2 and the other to terminal A of the transformer. Examine the connection at pin 5 of V2 carefully. Bend the socket pin and wires as necessary to prevent any accidental contact with another wire or pin. Wire FF should be run between the shielded wire you have just installed and the chassis.

139. Prepare a .001-mfd disc capacitor as in step 78 and Fig. 26. Tip up your chassis so that its right edge and two of the long screws which go through E holes are on the table. Place the .001-mfd disc capacitor in the position shown in Fig. 45, so that its wires rest on terminals A and C of the transformer. Then solder to those terminals. Return the chassis to its normal position.

140. Cut a 7½" length of grey double shielded cable, SF in Fig. 45. Prepare both ends as in step 137. However, at the end where the shield wire is allowed to remain, remove only ½" of insulation, so that each of the inner conductors is only ½" long. Remove about ¼" of insulation from the end of each inner conductor. At the other end cut away the shield entirely and attach two magnetic head clips, just as you did in step 137. At the end having the shield wire, solder the shield wire to the bare wire which runs between V3 and V6, quite close to pin 7 of V3. (See SF in Fig. 45.) The cable should be above the bare wire. There should be only about ¼" of shield wire between this bare wire and the cable. Be sure that all the shield wire which is exposed is covered with solder so that it is stiff and

movement of the cable will not cause the shield wire to touch any socket pins. Now solder one of the inner conductors to pin 6 of V3, and the other to pin 8 of V3. Examine all your work carefully to see that no matter how the shielded cable is moved, the shield and conductors cannot touch anything they shouldn't.

141. Cut a 9" length of the single shielded cable with stranded inner conductor; this has a black outer jacket. Remove ½" of insulation from one end, then unwind the shield wires and twist them together to form a single wire. Remove about ⅛" of insulation from the end of the inner conductor. Solder a magnetic head clip to the inner conductor and another to the end of the shield wire. Always be careful with these clips to avoid allowing solder to run down inside the enclosed part. If you have accidentally done this, heat the enclosed part by placing the iron on the outside, and then just as you remove the clip from the iron shake it vigorously. Remove ¾" of insulation from the other end of the cable. Unwind the shield wires and twist them into a single wire. Remove about ¼" of insulation from the inner conductor. Separate the shield wire and the conductor so that they are in the position shown in Fig. 39. See cable SG in Fig. 46. Hold the cable so that most of its length hangs over the right side of the chassis, and the shield

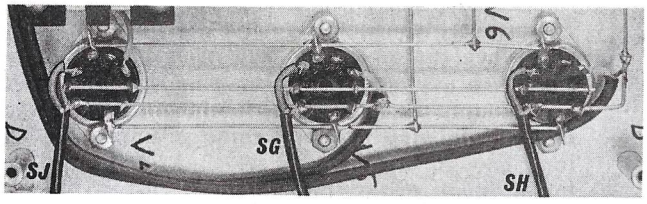

Fig. 46 — Shielded cables with stranded inner conductors soldered to V4, V5, and V6 (SH, SG, SJ). Again, solder the shields close to cable body so they cannot touch anything when wire is moved.

wire points to the top of the chassis, that is toward V5. The end of the cable with which you are dealing is positioned between V4 and V5. Clip off all but about ¼" of the shield wire. Now apply the soldering iron to pin 1 of V5 to soften the solder which has filled its hole. At the same time, use the soldering iron to push downward the bare wire which is passing through pin 1. This will make enough room in the hole of pin 1 so that you can push the end of the shield wire up through it. Push it far enough so that the body of the cable is only about 1/16" from pin 1. Now apply a little more solder so that the shield wire is firmly connected to pin 1 of V5. The purpose of this is to make sure that when the cable is moved in future the shield wire, which is connected to pin 1 of V5, cannot move around and touch any of the other wires or pins. Clip off the excess shield wire emerging from pin 1. Solder the inner conductor to pin 3 of V5.

142. In exactly the same way cut two more 9" pieces of black single shielded cable, preparing both ends of each just as you did in step 141. One of these, cable SH, is connected with its shield on pin 1 of V6 and the inner conductor on pin 3 of V6. The other, marked SJ, is connected with shield on pin 1 of V4 and the inner conductor on pin 3 of V4. Examine all three carefully to see that no matter how the wire is moved, nothing can touch anything it should not. All three wires should have magnetic head clips on their far ends. Fig. 46 shows these three cables installed.

Power Cable

143. Now put the chassis aside and prepare your power cable. This is the thick grey cable which contains 8 colored wires. You will also need your 8-prong plug. Begin by removing the cap from the plug. Put the cap aside.

144. Remove exactly ½" of the outer grey insulation from one end of the cable. Be careful not to nick the insulation of any of the inner wires. If there is thin transparent plastic under the outer insulation, remove that also. Remove about ⅛" of insulation from the end of each of the 8 conductors. Note that this is No. 18 wire, so if you are using a wire stripper, set the stripper or use the proper notch for No. 18. The wire you dealt with previously was No. 22, and if you do not use the stripper properly, you will cut away some of the strands of the power wires. Twist the strands of each wire tightly together and apply a thin coating of solder. Do not apply too much solder or the wires will not go through the holes in the plug terminals. The purpose is to prevent the strands from separating when you push them through the plug terminal holes. It may appear at this time that attaching the wires to the plug terminals would be a little difficult with the wires emerging only ½" from the cable. This is necessary, however, and you should follow directions exactly.

145. If you have a small vise it will be helpful to clamp the plug body in it so it will stand still while you are working on it. Be sure not to clamp it tight enough to crack the plastic. Have the connection terminals facing upwards, with terminals 1 and 2 to your left. With the body of the cable extending outward to your right, pass two wires through terminals from right to left — red through terminal 3 and green through terminal 4. Spread the other wires out to either side to keep them out of the way. Push these two wires into the terminals all the way up to the insulation. Then solder them to the terminals and clip off all excess wire. Use enough heat to make a good joint but do not leave the iron necessarily long on the wire or terminal so as to melt the insulation.

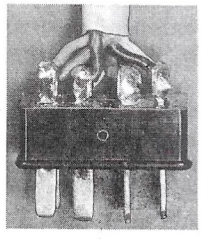

Fig. 47 — Wires of power cable soldered to 8-pin male plug. Each wire must be well soldered and adequately separated from others to avoid accidental contacts. All should be short enough so when cap is added, gray outer insulation extends inside cap.

146. With the body of the wire in the same position, solder the black wire to terminal 1 and the yellow to terminal 2. Use long-nose pliers to get the wires through the terminals, as the short wire lengths exposed do not give much room for flexibility.

147. Now flop the wire over so the main body of the cable is leading off to your left. Solder the brown wire to terminal 5 and the white to terminal 6. If

absolutely necessary in order to make a wire reach where it is going, you may at any time cut back the outer grey insulation slightly.

148. Finally, solder the blue wire to terminal 7 and the orange to terminal 8.

149. Examine all your connections with great care to see that every joint is well soldered, and that no pieces of bare wire extend far enough away from their terminals so that when the cable twists and turns accidental contacts can be made. An *insulated* part of a wire can, of course, touch another terminal without harm.

150. Slide the plug cap over the other end of the cable and down to the plug. Fit it over the plug body. Notice that there is a hole passing through the plug body, and corresponding holes on either side of the cap. Find your plug pin, which looks something like a nail but has flutes. Push it into the hole in one side of the plug and force it right through so that the tip comes out the other side. You can tap it through with a hammer. Be sure the tip of the plug comes out past the cap so that both sides of the cap are caught and the cap cannot slip off the body of the plug. Now tighten the cable clamp screws until the two parts of the clamp meet. Be sure the cable is in the center of the clamp so that none of the wires get pinched under the ears on both sides.

151. Prepare the other end of the power cable as follows. Remove 6" of the outer grey insulation. Do not cut the black wire; remove about 1/4" of insulation from its end. Cut the brown wire down to a length of 1 3/4" from the end of the grey insulation, and remove about 1/4" of insulation from its end. Cut the orange and blue wires down to 3" and remove about a 1/4" of insulation from the ends. Cut the green wire down to 1 1/2" and remove about 1/8" of insulation from its end. Cut the red wire to 4" and remove about 1/8" of insulation from its end. Cut the white wire to 2 1/2" and remove about 1/8" of insulation from its end. Cut the yellow wire to 3 3/8"; remove enough insulation so that 2 5/8" of the bare wire is exposed.

Assembling Chassis and Mechanism

152. Go back to the chassis and label the 5 shielded cables connected to it. The best way is to use a strip of adhesive tape (white) wound around the cable at about its center. Mark the designations on the tape in ink. Mark the cable which comes from V4 "1," the cable from V5 "2," and the cable from V6 "3." Mark the cable from V3 "E," and the cable which is connected to V2 and the solder lug in hole A "R." These markings indicate the cables which are to go to the record head, the erase head, and playback heads 1, 2, and 3.

153. Remove your Main Unit carefully from its packing. Take off the cover by removing 3 knurled nuts. Do not at any time knock anything against any part of the mechanism or the recording heads on the front face. *Do not "tighten" any screws or make any other adjustments.* Do not disturb the tape and its cartridge. If the upper section of tape is not across the heads, straighten it. If the tape below the rubber wheel does not go directly into the cartridge but hangs in a loop, turn the unit around and rotate the motor shaft by hand *counterclockwise* from inside the case. If anything on the face of the Main Unit seems definitely out of order or out of adjustment, due to shipping damage, consult your Service Manual. If the Service Manual and your own knowledge of the subject are not enough to resolve the difficulty, do not work on the unit at random, but write or telephone us for instructions, giving the exact nature of the problem.

154. If there is paper around the metal box, remove it and thereafter be careful not to scratch the finish. Now refer to your Service Manual and examine the photograph of the Main Unit, paying particular attention to the numbered callouts, so that you can identify the parts when they are mentioned in following instructions.

155. Insert a large rubber grommet in the large hole on the left edge of the box, into which the power cable will go.

156. Pass the free end of the power cable through this grommet from the outside, so that the bared wires are inside the Main Unit. Push the wire straight in so that it passes directly over the motor, between the rear of the face of the box and the mounting bracket which is on top of the motor. Then grasp the end and pull the power cable all the way through until the plug at the outside end is right up against the grommet. Push the box off to one side so that you can work with the end of the cable and the chassis which you have wired. You will now secure

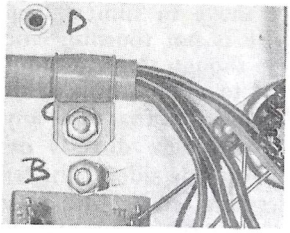

Fig. 48 — How cable clamp, fastened by screw, flat washer, and nut in hole C, holds power cable. Only enough of the outer cable jacket should be past right of cable clamp so clamp can hold cable firmly.

the end of the power cable to your chassis with the white cable clamp and also attach a double tie point on the other side of the chassis. As you do this, refer to Fig. 48 and Fig. 49. First place the cable clamp over the power cable and place the assembly in approximately the position shown in Fig. 48; the screw holding the cable clamp will later go through hole C. Now pass a 6-32 x 1/2 screw through the hole in the mounting foot of a double tie point (Fig. 49). Next, place a #6 lockwasher over the screw. Pass the screw through hole C, so that the double tie point is on the unwired side of the chassis. Notice in Fig. 49 the orientation of the tie point. Its body is away from the transformer can. Now pass the cable clamp holes over the screw, holding the cable in the position shown by Fig. 48. As the screw emerges from the cable clamp, pass a flat washer over it, and then a nut. Before tightening, draw the power cable back so that only about 1/8" of the

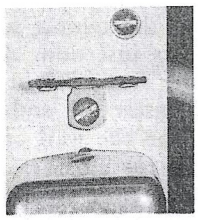

Fig. 49 — Double tie point on unwired chassis face is held by same screw as cable clamp; turn it to position shown.

jacket extends to the right of the cable clamp. Now tighten the screw. As you do so, see that the power cable and the double tie point are in the positions shown by Figs. 48 and 49. To tighten the screw thoroughly, you will have to hold the nut with a nutdriver or a pair of pliers, since a lockwasher is not possible under the nut. Tighten the screw as firmly as you can.

157. Lead the bared end of the yellow power-cable wire through the hole in the solder lug attached to hole B, from left to right. Pass the end under the stiff bared wires, over to the slanted bare wire which passes through pins 1 and 7 of V3. Hook the end around this bare wire just below the V3 socket, clinch it, and solder. Arrange the length between the soldered point and the solder lug in hole B so it cannot touch any other wire; it can be quite close to the chassis, since it is a ground wire, but it should not touch. When you have arranged it properly, solder it also to the solder lug through which it passes. If you are using the Ungar iron for this, be sure to leave it in place long enough to heat the lug and solder thoroughly, as the chassis tends to drain away heat. Now apply a little solder to the length of bare wire between the solder lug and the stiff wire, so that the stranded wire becomes stiff and cannot move in future. Inspect again to see that the wire is not touching another wire or the chassis. Even though this is a ground wire, it should be connected to ground only at the solder lug, and should not touch the chassis at any other point.

158. Pass the brown wire directly over to the center terminal (E) at one side of the transformer. Secure it to the terminal and solder it, soldering also the brown wire presently on terminal E.

159. Lead the green wire directly to pin 4 of V3 and solder it, soldering at the same time the bare wire already in pin 4.

160. Lead the end of the white wire around the top of V3 and pass the end through pin 9. Solder it, soldering also the bare wire already in pin 9.

161. Lead the red wire directly over to pin 7 of V6. Solder it, soldering also the bare wire which passes through pin 7 of V6.

162. Pass the black wire, by the most direct path, and under all the bare wires, to pin 8 of V7. Solder it there, soldering at the same time the black wire already present. See that this pin is safely far from any adjacent bare wires, so that it cannot touch them under any circumstances. Lead the blue and orange wires over the top edge of the chassis and connect each wire to one terminal of the double tie point mounted on the unwired side of the chassis. Solder each one in place, but do not fill the hole in the terminal with solder, as the motor wires will later have to be connected here.

163. You are now ready to place the chassis in the cabinet. First pull the motor wires off to the right, as you face the rear of the cabinet so they will not interfere with chassis insertion. An easy way to keep them out of the way is to bring them around the box edge and insert the ends in two of the four holes provided on the wall of the chassis for later mounting, *from the outside.*

164. Bring the chassis close to the metal box, drawing the power cable out through its grommet as you do so. The wired side of the chassis will face the inside front wall of the cabinet. When the chassis is close enough to the cabinet, insert your hands and place the five shielded cables through their holes so that the ends with the magnetic head clips come out the front of the box. Refer to the illustration of the Main Unit in the Service Manual. Place the cable labelled "E" through the hole under the erase head, the "3" cable through the hole under playback head 3, the "2" cable through the hole under playback head 2, the "1" cable through the hole under playback head 1, and the "R" cable through the hole under the record head. To do this may require a few tries. Obviously the end of the chassis nearest the motor must be pushed in close to the chassis first, and the power cable pulled in gradually. If you find your hands are too large, borrow the services of someone with smaller hands and wrists. As little cable as possible has been left for this purpose, since once the chassis has been installed, excess cable is a liability. If you find that wires previously inserted through holes tend to pull back when you try to insert others, an ordinary spring-type clothespin or an alligator clip attached to the end of the cable outside the box will keep it from popping back through the hole. After checking to see that all cables are through their holes, slowly work the chassis all the way in until it is parallel to the rear face of the cabinet front, spaced away only by the threaded spacers. When it is correctly positioned, the double phono jack will appear and will be entered in the oval hole labelled IN and OUT, and the control socket will fit into the round hole labelled CONTROL. Do not pull the 5 cables through their holes any more than necessary to allow you to connect them to the pins of the heads. Let the slack cable stay inside the box. A convenient way to handle the chassis when it is most of the way in is by grasping the transformer can. Be careful, however, not to twist this too violently.

165. When the chassis is properly in place, you will be able to look through the 5 holes around the edge of the front and see the ends of the threaded spacers attached to the chassis. Be certain that it is possible to push the chassis in so that each of these spacers is against the metal. If you cannot do this, it means a cable is caught between the box and some element on the chassis. Forcing would possibly cause trouble. So if this happens, ease the chassis out just far enough to look and see what is happening. When all is well, use 6-32 x ½ screws through these 5 holes into the threaded spacers to hold the chassis in place. Put in all screws loosely, make sure the chassis is properly placed, as evidenced mainly by the fact that the control socket fits into its hole, then tighten the screws one by one.

166. Cut off enough of each of the two motor wires so that the remaining wire extends about 1½" to the rear of the transformer top. Remove about ¼" of insulation from the end of each wire. Then solder one wire to each of the two terminals of the double tie point on the chassis.

167. Attach the clips at the ends of the 5 cables to the terminals of the 5 magnetic heads. To do this, simply slip the clip over the terminal. Test each one as you do this to be sure it is tight. If it can be removed too easily, squeeze the terminal gently between long-nose pliers, so that the spring grip is firmer. It makes no difference which of the two clips go to which

of the two terminals on the record and erase heads. On the 3 playback heads, first attach the clip at the end of the insulated wire to the head terminal nearest the box face, then attach the clip on the shield wire to the remaining terminal. After doing this, push excess cable back through the hole into the cabinet. However, if this is difficult, do not force it in. No harm is done if excess cable is left outside the box.

168. You will notice that a large brass flywheel is packed separately in the carton with the Main Unit, and attached to the flywheel with a bit of tape is an Allen wrench. Remove the Allen wrench and the tape. Press the flywheel onto the motor shaft inside the box, with the setscrew toward the rear of the box so you can reach it. Press the flywheel onto the shaft only enough so that the rear end of the shaft is approximately flush with the rear face of the flywheel, not farther. Then use the Allen wrench to tighten the setscrew, holding the flywheel firmly in place. If you want to rotate the flywheel by hand just to test it, rotate it counterclockwise (to the left, facing the rear of the Unit) only.

Control Assembly

169. You will now make up the Control Assembly, for which you will need the 3-gang potentiometer, a 7-pin plug and rubber cap, and your piece of brown cable containing 6 shielded wires. The cable is supplied as a 6-foot length and there is no harm in using the entire length, even though your control may not be 6 feet away from the Main Unit as finally mounted in your organ or audio equipment. However, if you are certain that the distance will be appreciably shorter, and you wish to avoid having an unnecessary cable length, you may cut down the cable to whatever length you find suitable. No advantage in quality of operation results from cutting down the cable; you may wish to do it simply as a matter of extra neatness in installation.

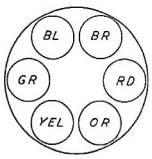

Fig. 50 — Find end of cable at which the wire colors are in this sequence. This is the end which connects to the 7-pin plug. The bare wire is not shown.

170. Find the end of the cable at which the wire colors run numerically in a clockwise direction, as indicated in Fig. 50. At this end of the cable remove not more than 3/8" of the outer brown jacket. Be careful in doing this not to cut into the shielding or insulation of the inside wires. After you have removed this outer jacket, you will see that in addition to the 6 shielded wires, there is an additional bare wire in the cable. It may be twisted or solid. Be sure to distinguish it from the shield wires. Cut away any exposed twine filler and transparent wrap.

171. Grasp the ends of the wires and pull the jacket back forcibly so as to expose more of the wires without cutting more of the jacket away. Separate each wire from the rest and unwind its shield wire. Cut away all shield wire as close to the end of the jacket as possible. Be careful not to cut the bare wire which passes through the cable.

172. Carefully remove about 1/4" (not more) of insulation from the end of each wire. Then tightly twist together the strands of each wire and tin each twisted wire by melting a small amount of solder on it so as to stiffen it and hold the strands together without appreciably adding to its bulk.

173. In soldering wires to plug terminals, remember again that the numbering is *counterclockwise.* This is especially important for those familiar with electronics, as the terminals of this plug look like the base of a tube socket. However, since the unit is a plug equivalent to a tube base, the numbering is counterclockwise, not clockwise. Bend a hook in the bared end of the brown wire; hook the wire to terminal 1 and clinch it. See that the insulation comes right down to the terminal and cut off any unnecessary wire at the end of the hook. Then solder. The point of these precautions is to avoid any possibility of two wires touching each other after the unit is completed and the cable is able to move. In the same way solder the red wire to terminal 2, the orange wire to terminal 3, the yellow wire to terminal 4, the green wire to terminal 5, and the blue wire to terminal 6. This is small and rather delicate work. Do it carefully. Finally solder the bare wire to pin 7. Arrange the bare wire between the jacket and the terminal in such a position that it is away from the other wires. Then add a little solder along the wire to stiffen it and prevent it from moving. Do not apply enough heat to melt the insulation of any wire with which it may be in contact.

174. Carefully examine all connections and flex the wire slightly to see that nothing can accidentally touch anything else. Then grasp the cable about a foot from the plug in thumb and forefingers of both hands. With one hand left in position, slide the other one toward the plug, exerting pressure as you go. This will push the jacket up as close to the plug terminals as it can go. Slide the rubber cap over the other end of the cable, large end first. When it gets to the plug, force it over the body of the plug. This completes the plug end of the control cable.

175. Remove 1 3/8" of the outer jacket from the other end of the control cable. Make sure that all 6 shielded cables as well as the bare wire are 1 3/8" long. Hold on to the ends of the wires with one hand and with the other hand pull back the jacket as far as possible, just as you did at the plug end. Unwind the spiral shielding from each wire, and cut off the shielding as close to the end of the jacket as possible. Then push the jacket up again so that its end is within 1 3/8" of the ends of the wires and it covers the ends of the shields. Remove about 1/4" of insulation from the end of each wire.

176. Decide now how the potentiometer will be mounted. If it will be mounted on a wood board 3/4" thick, the shaft of the control need not be cut. If it is to be mounted on a panel of any other thickness, whether wood, plastic, or metal, use a hacksaw to cut down the shaft so that dimension X in Fig 51 is equal to the thickness of the mounting surface plus 5/8". Round off the end of the shaft with a file so that no burrs will prevent the knob from going over it. Test by temporarily slipping the knob on the shaft. If necessary, this shaft cutting can be done just before installation, but it is easier to do now if feasible.

177. Fig. 51 is a diagram of the 9 terminals of the potentiometer. With the end of a pair of long-nose pliers, bend the ends (the parts having the holes) of terminals A, D, and G up so each entire terminal is at right angles to the control body. Then pass the bare wire of the cable through G, D, and A in that order. Pull the wire through until the end of the outer jacket of the cable is not more than 1/8" from terminal G. Then bend a loop in the wire after it passes through terminal A to hold it in place, and solder to all 3 terminals. Clip off excess wire past terminal A.

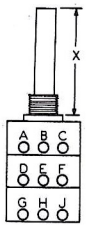

Fig. 51 — The control potentiometer. Instructions refer to terminals by these letters. Unless you will mount control on a 3/4" wood panel, cut down shaft before wiring so dimension X is 5/8" longer than thickness of panel.

178. Solder the blue wire to terminal H and the red wire to terminal J. Solder the green wire to terminal E and the orange wire to terminal F. Solder the brown wire to terminal B and the yellow wire to terminal C. This completes the control wiring. Between now and installation, do not flex the cable too much, as it is mechanically secured to the control only by the bare wire, and too much twisting could break this.
179. Cut your small length of plastic tubing into 3 pieces of about equal lengths, none longer than 2 inches. Push a piece over each of the 3 long screws projecting rearward from the chassis which is in the main cabinet. Push each piece down until it touches the nut.
180. Place the Main Unit on the table in front of you, with its back toward you, and the brown phenolic rear cover plate on the table with the white lettering toward you, in such a way that the shape of the plate matches the shape of the chassis. Plug your attenuator (see your Installation Kit) into the 7-pin socket on the chassis. Plug all the modules except the 105 modules into the 9-pin sockets on the chassis, making sure each one is in the correct socket, as identified by the lettering on the rear cover plate. Be quite certain you have each module in the correct socket. Now add the 105 modules, making certain that 1, 2, and 3 go into the proper sockets — #1 at bottom and #3 at top. Inserting the modules may take several tries, as you cannot, in some cases, see the socket. However, never force a module into place, as this may bend the pins. When you have found the proper position and orientation, each module will slip in easily.
181. Notice that the brown rear cover plate has three small holes in it. Slip the cover plate into place, so that the three long screws projecting backward from the chassis go through the three small holes. (Bend screws slightly if necessary.) Thread a 6-32 nut on each screw in back of the cover plate. As you tighten the nuts with a nutdriver or pliers, move each of the tube sockets with your finger, so that each socket is approximately centered in its hole. Tighten the nuts enough so the cover plate cannot move, but do not use excessive force. Now insert in each tube socket the tube called for by the white lettering on the rear cover plate. Be sure you use the correct tube types — 12AX7 or 12AU7.

This completes assembly of your REVERBATAPE Unit. Now refer to your Installation Kit for instructions and materials for installing it in your organ or audio equipment. If you have any difficulties, see the Service Manual or write to Schober for advice. Be sure the tape is in good condition and properly threaded, and that the metal-plastic cover is in place after you install the Unit.